B.C.Hydro

Skeena-Rupert
500 kV Transmission Line
Environmental and Socio-Economic Assessment
Volume I — Text

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SUMMARY

INTRODUCTION

INVENTORY

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SKEENA-RUPERT
500 kV TRANSMISSION LINE
ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT
VOLUME I - TEXT

Report No. ESS-20 March 1983

B.C. HYDRO
ENVIRONMENTAL AND SOCIO-ECONOMIC SERVICES
ENGINEERING SERVICES DIVISION

SKEENA-RUPERT

500 kV TRANSMISSION LINE

ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

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SECTION 1.0 - PREFACE

B.C. Hydro is planning a 500 000 volt (500 kilovolt) transmission line from Skeena Substation near Terrace to Rupert Substation near Prince Rupert for an in-service data in 1988.

This report, prepared by Environmental and Socio-economic Services Department of B.C. Hydro, provides detailed information on the potential impacts of the proposed 500 kilovolt (kV) transmission line and possible mitigation measures. The report has been prepared in accordance with the Guide to the Energy Project Review Process published by the Ministry of Energy, Mines and Petroleum Resources in 1982.

An engineering report entitled "Route Engineering Assessment of the Skeena-Rupert High Voltage Transmission Line" has been prepared by the Transmission Projects Division of B.C. Hydro and is available as a companion document. The engineering report examines all technically feasible routes with emphasis on transmission line design, construction, maintenance and security.

A planning report for this project entitled "Skeena-Rupert 500 kV Transmission Line Preliminary Planning Report" has been prepared by the System Planning Department of B.C. Hydro. It discusses project justification, planning and route alternatives.

Following discussion of the project and routing possibilities with the public and government agencies, a preferred route will be determined and an application prepared for an Energy Project Certificate under the B.C. Utilities Commission Act.

A public consultation program will begin with the release of this and other reports on the Skeena-Rupert 500 kV transmission line. Anyone wishing further information on this project is invited to contact

Community Relations Department, B.C. Hydro, 970 Burrard Street, Vancouver, B.C. V6E 1Y3 or telephone 663-4344 (collect if long distance).

SUMMARY

SECTION 2.0 - SUMMARY

INTRODUCTION

B.C. Hydro is proposing to construct a 500 kV transmission line from Skeena Substation near Terrace to Rupert Substation near Prince Rupert. The new line would provide increased capacity and security of supply for Prince Rupert.

This environmental study meets the major requirements for impact assessment outlined for the Application Phase in the "Guide to the Energy Project Review Process" issued by the Ministry of Energy, Mines and Petroleum Resources. The report describes the biophysical and socio-economic resources of the area between Terrace and Prince Rupert, identifies areas sensitive to disturbance, offers mitigation recommendations, evaluates impacts which would occur despite mitigative attempts, and recommends an environmentally preferred route.

INVENTORY

Biophysical Resources

The Terrace-Prince Rupert area is characterized by the high precipitation and moderate maritime climate typical of coastal areas. The Skeena River and the Coast Mountains are the two major physiographic features in the area. The Skeena River floods seasonally due to snow and glacier melt in the summer and high rainfall in the autumn. The Kitimat Ranges of the Coast Mountains consist mostly of eroded granitic rocks which have been extensively glaciated. Steep rugged mountain sides and high precipitation combine to make avalanches, landslides and other mass-wasting processes common. Soil is organic in bog areas, podzolic in most forest areas and regosolic on recent alluvial parent materials.

The vegetation is characterized mainly by the communities of two biogeoclimatic zones, the Coastal Western Hemlock zone and the Coastal Cedars Pine Hemlock zone. At elevations above 600 to 1000 m, communities of a third zone, the Mountain Hemlock zone, are dominant. Up to 22 species of rare or endangered plants may occur in the study area.

Moose, deer, mountain goat, bears, wolves and cougars are the big game wildlife species found in the area. Moose are the most abundant big game. Sitka black-tailed deer are important in the western portion of the area. Mountain goats are present in rugged terrain throughout the Skeena watershed. Black and grizzly bears and wolves are common. Twelve species commonly considered furbearers occur including six mustelids, lynx, coyote, fox, beaver, muskrat and squirrel. The harbour seal is often sighted in the rivers as far east as Terrace. Large numbers of small mammals are also present. The estuarine area of the Skeena is important winter habitat for geese, ducks and swans, as well as for spring and fall migrants. Upriver of the estuary, wetlands support migrating waterfowl. Trumpeter swans winter in and near several Skeena tributaries. Upland game birds, bald eagles and numerous other bird species are common.

The Skeena River is second to the Fraser River as a producer of salmonid fish in British Columbia. A significant portion of the 1.7 million Skeena River fish commercially landed annually arise from the study area. Thirty fish-bearing streams and lakes occur in the area. The most important aquatic resources from a social and economic standpoint are the anadromous salmonids which include pink, chum, sockeye, chinook and coho salmon, steelhead and cutthroat trout and Dolly Varden char. Eulachon, an anadromous smelt, spawn in the Skeena River mainstem. The most common freshwater fishes are resident rainbow trout, Rocky Mountain whitefish, northern squawfish, redside shiner, peamouth chub, three-spine stickleback and prickly sculpin.

Resource Use and Socio-economic Resources

There is little present agriculture in the area although much of the eastern half of the proposed transmission routes crosses land of moderate to good agricultural potential. One farm near Shames is engaged in commercial vegetable production. The main constraints to development are the limited size of local markets and distance from large population centres. High costs of access roads, clearing, drainage, and dyking also deter development.

The forests of the middle and eastern portions of the area are highly productive, with western hemlock, red cedar and amabilis fir the dominant and most highly used species. The forest industry is of key economic importance to the Terrace - Prince Rupert area. Logging occurs throughout the area. There is a pulpmill at Port Edward and two sawmills, two pole companies and a shake and shingle mill at Terrace.

Known geological resources include three base metal prospects, two industrial mineral deposits and numerous aggregate deposits. Of these, the industrial deposits have been utilized at various times in the past and the aggregate deposits are actively in use for road and other construction purposes.

Several heritage sites are known and more are likely to be discovered because of the historic role of the Skeena River as a transportation route and food source. Recorded heritage sites include pictographs, burial sites and general activity sites.

Recreation is an important resource use, both for local residents and for tourists. All three provincial parks are heavily used, especially by local residents for camping, angling, picnicking and boating. Hunting is light, limited by lack of access.

The Skeena valley is an important tourist route as well as a key commercial rail and highway corridor. The outstanding scenery is a major factor in the enjoyment of the area by residents and tourists. Rugged mountains, the island-dotted riverscape and the towering coniferous forests contribute to the visual resources of the study area.

Portions of 22 traplines are located in the area, nine of which have been active in recent years. There is one guide-outfitter territory in the area. Subsistence hunting is thought to be minimal. A commercial fishery in the Prince Rupert area harvests salmon destined for the Skeena River and two native food fisheries are in operation.

Prince Rupert, Port Edward and Terrace are the major population centres in the area. Settlement is sparse along the proposed route, with Shames (pop. 4) being the largest permanent community in the valley. Nineteen Indian reserves assigned to the Port Simpson, Metlakatla and Kitsumkalum bands are located in the area. Of these, eighteen are unoccupied.

IMPACTS

Biophysical Resources

Problems of erosion and siltation could occur but would be lessened if the transmission line is located on stable terrain types. The transmission line or access roads could alter plant communities in sensitive vegetation types such as tidal marshes, aquatic communities or bogs. However, such types can usually be spanned or avoided. Where access roads are involved, proper drainage must be maintained to ensure the survival of existing plant communities.

Impacts on wildlife and aquatic resources would be mostly low or moderate because critical habitats can usually be avoided. Wildlife habitat would be altered by right-of-way clearing and construction, but careful construction timing, avoidance of critical wintering areas and maintenance of shrub cover through vegetation management could partially compensate for these changes. Line location through trumpeter swan wintering areas could present collision hazard problems.

Special measures would be required to resolve potential conflicts. Access planning and erosion control are critical for the protection of aquatic resources and fish habitat. Some salmon spawning areas would be crossed by the line, and others are downstream of areas in which the channel substrate would be disturbed. Construction timing constraints and other protective measures would be required.

Resource Use and Socio-economic Resources

The agricultural impact would generally be low. Although approximately one-third or 40 km of the transmission line route would cross Agricultural Land Reserve (ALR) land of classes 1-4 capability, the existence of a transmission line would not preclude future development. If the line crosses the commercial market garden at Shames there would be a relatively high impact in that segment.

Between 320 and 450 ha of good and medium site forest land would be removed from the forest land base on right-of-way areas. The major form of mitigation for forestry is careful alignment, but it is not possible to align the route consistently through poor growing sites because of other environmental or technical constraints. Forestry impacts would be highest in the Prudhomme and Lachmach segments where future forest harvesting on steep slopes above the transmission line would be restricted, causing losses in addition to those calculated for the route itself.

Mining impact would be low because deposits can often be avoided and most known deposits are aggregate sources which are plentiful throughout the area.

A number of heritage sites are likely to be found during future surveys, but these and known sites can usually be spanned to avoid impact.

Short term recreation impacts such as reduced use would stem from construction near park and other high-use areas. The long term impact to recreation is the alteration of the visual resource. In an area as scenic and well-travelled as the Skeena River valley, the presence of a transmission line is perceived by most people to be an intrusion on the natural landscape. The additional line and right-of-way would be exposed to view from many places along Highway 16, from Exchamsiks and Prudhomme Provincial Parks and from Shames. Visual impact would be lowest in areas where the proposed route is adjacent to the existing transmission line.

The regional impact on land use is to expand the utility corridor in a valley where the predominant land use is transportation and where little settlement or development is expected in the immediate future. Impact on private properties will be minimal and will be concentrated at either terminus of the route. Two unoccupied Indian Reserves would be traversed. Overall, the impact on land use is expected to be low.

There are three potentially impacted population groups in the project area: The municipalities at the ends of the proposed route; the residents living along the route; and three Indian bands who have reserve land within the corridor. The project is not likely to affect the economic base, population, or lifestyle in the municipalities to any extent because the size of the work force would be small, and the construction period would be short. Settlement along the route is sparse hence the direct impact of the line on local residents is not expected to be significant except for a family at Shames whose land would be crossed if the Shames south segment is part of the selected route. A study to determine the impact on Indian bands in the area is underway.

Preferred Route

The route expected to have the fewest adverse impacts follows existing rights-of-way wherever possible, and consists of the following segments: Kloiya (A), Rainbow-Tyee (B, D), Khyex (F), Telegraph (H), Khtada (I), Mt. Bucey (J), Salvus (L), Exchamsiks Ridge (N), Mt. Jackman (O), Exstew (Q), Crossing (S), Dasque (W), and Lakelse (R)

(Maps IS 1-7). In the area between km 70.0S and km 86.5, the study team recommended that an alternative to segments K or part of J, L, M or N, and part of O be considered because of its significantly less adverse effects on wetlands important for wildlife, agricultural land, and visual resources along Highway 16 (Maps IS-4 to IS-5).

The potential for environmental degradation can be reduced to a large extent by good construction practices, careful final alignments, avoidance of sensitive habitat areas by construction crews at certain times of the year, undertaking a heritage resources survey and the development of an overall access plan and a sound vegetation management policy. An environmental protection program which includes incorporation of environmental standards in contract specifications, and provides for surveillance and monitoring during construction, would also help reduce adverse environmental effects.

SECTION 3.0 - INTRODUCTION

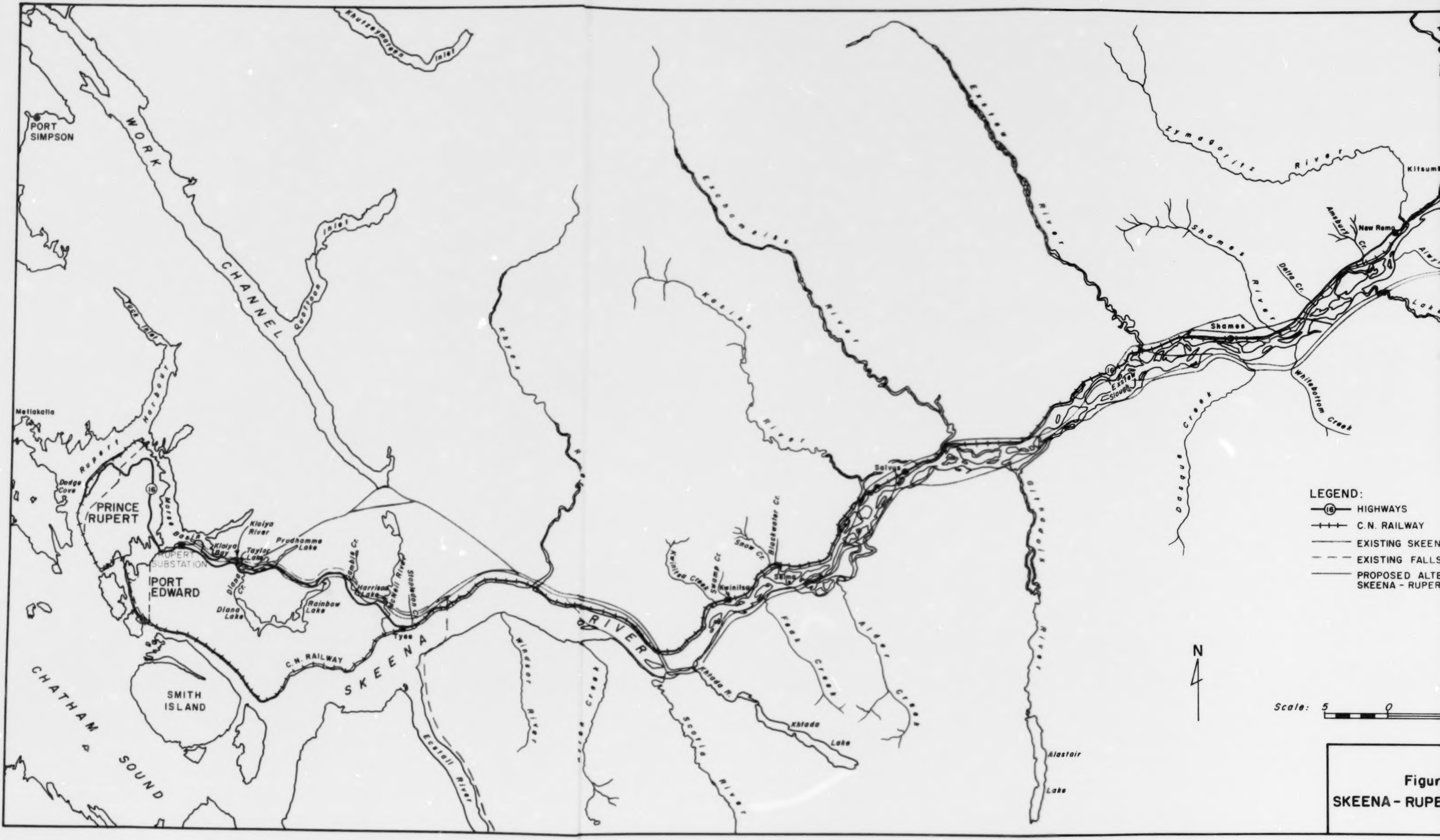
3.1 BACKGROUND AND OBJECTIVES

B.C. Hydro is proposing to construct a 500 kV transmission line in the Skeena River valley. The intent is to provide increased capacity and security of supply for Prince Rupert customers. This report has been prepared by B.C. Hydro's Environmental and Socio-Economic Services Department with the assistance of other B.C. Hydro departments and independent consultants (Appendix K). It will be used in the selection of a route for the transmission line.

The study area consists of corridors ranging in width from 2 to 5 km. The area centres around the routes outlined on Fig. 3.2-1 which connect Skeena and Prince Rupert substations. Most of the routes included are documented in the Route Engineering Assessment of the Skeena-Rupert High Voltage Transmission Line (B.C. Hydro 1983) but some are additional ones suggested as alternatives at various stages in the environmental studies.

The study was originally undertaken in 1980 to assess the impacts of a proposed 287 kV transmission line and conformed to the Stage 2 level of assessment outlined in the "Guidelines for Linear Development" (Environment and Land Use Committee 1977). In 1982 the inventory information was reassessed to determine the impacts of a 500 kV transmission line. This reassessment meets the major impact assessment requirements outlined for the Application Phase in the "Guide to the Energy Project Review Process" (Ministry of Energy, Mines and Petroleum Resources 1982).

The assessment focuses on the proposed transmission line. The general impacts of access are noted, but until engineering studies are more advanced, site-specific details will not be available.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Rupert
Dodge Cove
PRINCE RUPERT
16
Morse Basin
Kloiya River
Kloiya Bay
Taylor Lake
Prudhomme Lake
RUPERT SUBSTATION
PORT EDWARD
Diana Cr.
Diana Lake
Rainbow Lake
Gamble Cr.
Harrison Lake
McNeil River
Stapledon Cr.
Tyee
C.N. RAILWAY
SMITH ISLAND
CHATHAM SOUND
SKEENA
RIVER
Khyex River
Windsor River
Creek
Ecstall River
Scotia River
Khtada R.
Khtada Lake
Exchamsiks River
Kasiks River
Kwinitsa Creek
Swamp Cr.
Snow Cr.
Blackwater Cr.
Kwinitsa
Salmo
Salvus
Fook Creek
Alder Creek
Exstew River
Gitnadoix River
Alastair Lake
Zymagotitz River
Kitsumk
Shames River
Amsbury Cr.
New Remo
Delta Cr.
Shames
16
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Whitebottom Creek
Alwyn
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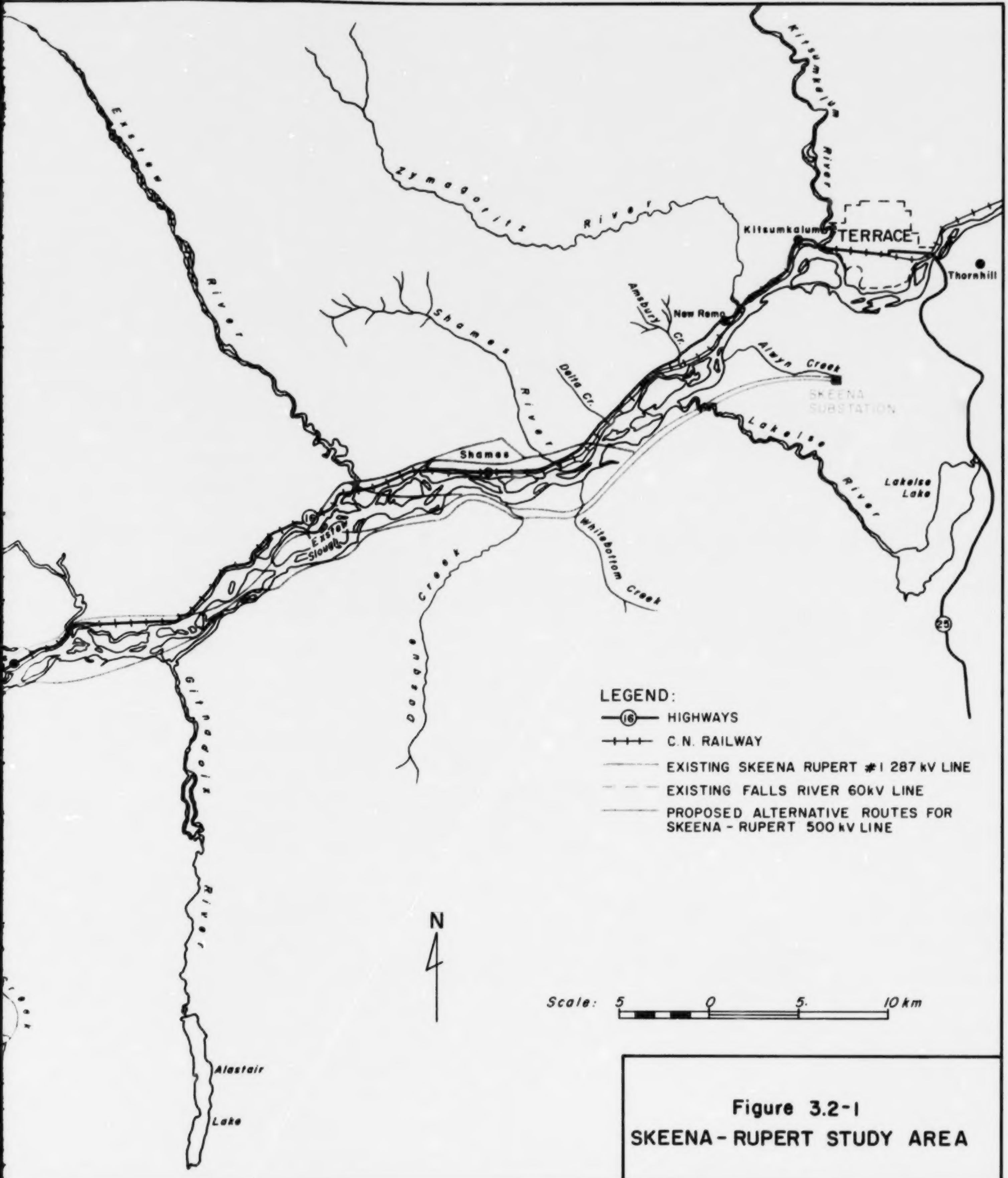
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Thornhill
Amesbury Cr.
New Remo
Alwyn Creek
SKEENA SUBSTATION
Shames River
Delta Cr.
Lakelse River
Lakelse Lake
Shames
16
Exstew Slough
Whitebottom Creek
Dasque Creek
Gitnadoix River
Alastair Lake
25
LEGEND:
HIGHWAYS
C.N. RAILWAY
EXISTING SKEENA RUPERT #1 287 kV LINE
EXISTING FALLS RIVER 60kV LINE
PROPOSED ALTERNATIVE ROUTES FOR SKEENA - RUPERT 500 kV LINE
N
Scale: 5 0 5 10 km

Figure 3.2-1
SKEENA - RUPERT STUDY AREA

The heritage study contained in this report, however, is of an overview nature only. A preliminary heritage impact assessment is to be published under separate cover in the spring of 1983. The detailed heritage impact assessment will probably be initiated in the summer of 1983, after centreline survey has begun.

Implications of the project for Indian resource and land use is the basis of a separate study, "Skeena-Rupert 500 kV Transmission Line: Assessment of Impacts on Indian Bands", which is currently underway.

The conclusions of this report are therefore considered tentative, requiring confirmation or amendment as new information is received. Information received during the public consultation program may also affect the conclusions reached in this report.

The objectives of the study were five-fold:

1. to describe the biophysical, resource use and socio-economic values of the Skeena-Rupert study area (Fig. 3.2-1),
2. to identify areas which are sensitive to disturbances of the kind which could occur with construction and operation of a transmission line,
3. to examine the proposed routes and recommend mitigative measures which would prevent or alleviate environmental disturbance,
4. to evaluate the impacts which would probably occur despite mitigative efforts,
5. where alternatives exist, to recommend a preferred route that minimizes environmental and socio-economic impact.

3.2 PROJECT DESCRIPTION

Technical and economic aspects of the proposed transmission line are documented in the Route Engineering Assessment of the Skeena-Rupert High Voltage Transmission Line (B.C. Hydro 1983). A brief description of the project is presented here.

The Skeena-Rupert 500 kV transmission line would provide a second connection between Rupert Substation, the station supplying electricity to the greater Prince Rupert area, and Skeena Substation near Terrace, the western terminus of the 500 kV system.

Prince Rupert presently has three sources of electricity: the Falls River hydroelectric generating station; the Skeena-Rupert 287 kV transmission line; and a gas turbine generating station which is used only as an emergency power source.

At present, if the existing 287 kV transmission line were to be removed from service during peak load periods, there would not be sufficient local generating capacity available to meet the power demands of the Prince Rupert area. Further, recent load forecasts indicate that by 1988/89, load growth in the area will exceed the capability of the existing transmission line to supply it. Consequently, a new transmission line has been planned for a late 1988 in-service date. Considering the growth anticipated for the Prince Rupert area and the economics of the supply alternatives available, it has been proposed that a 500 kV transmission line rather than a second 287 kV transmission line be built.

It is generally less expensive to locate new transmission lines adjacent to existing ones, however, in areas prone to hazards such as avalanches, landslides and floods, it is desirable to locate the new transmission line away from the existing transmission line for security reasons. This is often the case in the Skeena valley. The study area and existing and proposed transmission line routes are shown in Fig. 3.2-1. The precise alignment for the proposed line is not yet known, but the environmental studies have covered the whole study area and impacts resulting from minor changes can be predicted using the existing information base.

The transmission line would be approximately 125 km in length. The legal right-of-way width for the 400 kV transmission line would be 64 m. Where the proposed line is located adjacent to the existing line, the combined legal width of the right-of-way would be approximately 109 m. Average additional cleared widths would be 60 to 80 m, but may be up to double the legal width depending on slope and tree height.

Steel towers of both the self-supporting and guyed type would be used (Fig. 3.2-2). They would look similar to those on the line presently in service between Terrace and Telkwa. The average distance between towers is expected to be 500 m. The minimum clearance from the conductor to ground at the centre of a span would be 9 m.

The construction period from survey to commissioning of the line is expected to be 6 years and is presently planned for 1983 to 1988. The construction season (weather permitting) would be March to mid-October.

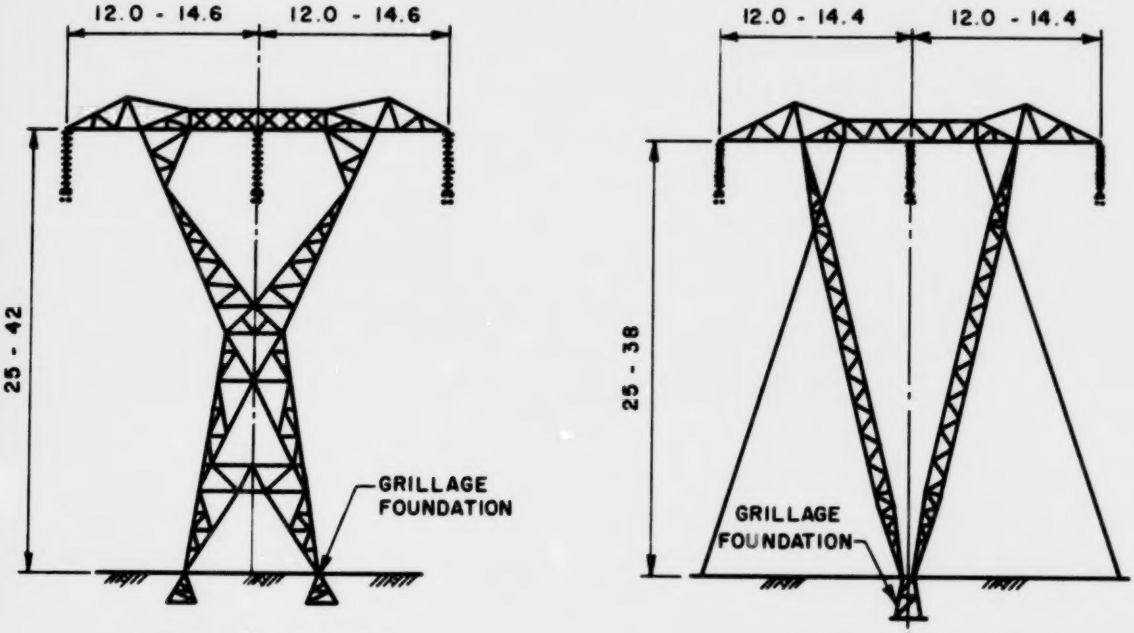
3.3 REPORT FORMAT

(a) Volume I - Text

To meet the objectives set out in Section 3.1, available published information, interviews with government agency staff and field work were utilized. The resulting inventory of the study area is in Section 4.0.

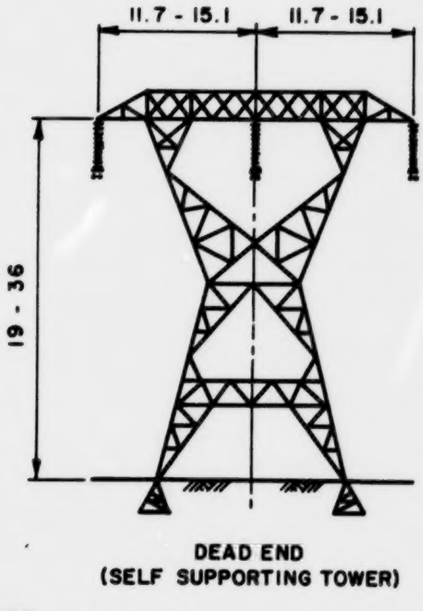
Section 5.0 includes analysis of sensitive areas, mitigation recommendations and impact assessment. Sensitivity was determined for each resource as high, moderate, low or nil throughout the study area. The

FIGURE 3.2-2
TYPICAL STRUCTURES SKEENA - RUPERT
500kV TRANSMISSION LINE


12.0 - 14.6
12.0 - 14.6
25 - 42
GRILLAGE FOUNDATION
12.0 - 14.4
12.0 - 14.4
25 - 38
GRILLAGE FOUNDATION

TANGENT & LIGHT ANGLE
(SELF SUPPORTING TOWER)

TANGENT & LIGHT ANGLE
(GUYED TOWER)


11.7 - 15.1
11.7 - 15.1
19 - 36

DEAD END
(SELF SUPPORTING TOWER)

NOTE: ALL DIMENSIONS ARE IN METRES.

ratings are factors of both the magnitude for potential degradation from the transmission project and the importance of a particular area to a given discipline. Sensitivity can also be described as the inherent potential for impact since it assumes normal construction practices but no mitigation.

Mitigation recommendations were made for the proposed routes, then the residual impacts of the routes were gauged on a scale similar to the sensitivity scale assuming that mitigation recommendations would be carried out. The impact scale allows positive as well as negative ratings. An impact can be described as high, moderate, low, nil, slightly beneficial, moderately beneficial or highly beneficial. Throughout the report, the term impact connotes negative or adverse effects unless beneficial impacts are specified.

Section 5.0 includes a general assessment of sensitivity, mitigation and impacts by resource (5.1) and a detailed assessment for each segment along the proposed routes (5.2). The routes were divided into segments at nodes of divergence to facilitate discussion of alternative routes.

Section 6.0 describes the methodology used to determine which routes would have the least environmental impact when all resources are considered, examines impacts of route alternatives, and recommends an environmentally-preferred route.

(b) Volume II - Maps

The map volume is intended to be used with the text. It consists of 11 sets of 1:50 000 study area maps: there is a combined inventory-sensitivity-impact map set for each of ten resources plus a summary map set which shows the multidisciplinary impacts of the proposed routes.

It is usually necessary for routes to be adjusted after the impact assessment document has been completed. The sensitivity maps can be used as a guide to potential impacts in areas outside the currently proposed routes. The sensitivity ratings can also be used as impact ratings in areas where recommended mitigation measures are not carried out.

INVENTORY

SECTION 4.0 - INVENTORY

SUB-SECTION 4.1 - BIOPHYSICAL RESOURCES

4.1.1 CLIMATE AND HYDROLOGY

(a) Climate

The climate of the Skeena valley west of Terrace is dictated by its proximity to the Pacific Ocean and the local topography of the Coast Mountains. The moderate maritime climate and heavy precipitation of the coastal zone is typified by the Prince Rupert record. Farther inland, the influence of continental weather systems causes greater temperature variations, decreased precipitation and increased snowfall as recorded at Terrace.

Mean daily air temperatures at Prince Rupert range from a high of 13.5°C in August, to a low of 1.7°C in January (Fig. 4.1-1). The more continental climate of Terrace has a more extreme range of mean daily temperatures, from a high of 16.1°C in July to -5.9°C in January. However, the mean annual temperature is only 2° cooler than Prince Rupert (5.9°C vs. 8.0°C). The pattern of greater temperature variation at Terrace is also reflected in the mean daily maximum and minimum temperatures (Fig. 4.1-1). The recording stations at Prince Rupert and Terrace lie on the Skeena valley floor, hence these data are not representative of higher elevation conditions.

The extremely wet conditions of the narrow Coast Mountain zone are indicated by the mean annual total precipitation of 2400 mm (water equivalent) at Prince Rupert. In contrast, the mean annual total precipitation recorded at Terrace is 1313 mm, reflecting a sharp gradient of total precipitation in the lower Skeena valley. The percentage of total annual precipitation falling as snow varies from 3 percent at Prince Rupert to 31 percent at Terrace. Most snowfall occurs in December and January while October is the month with the

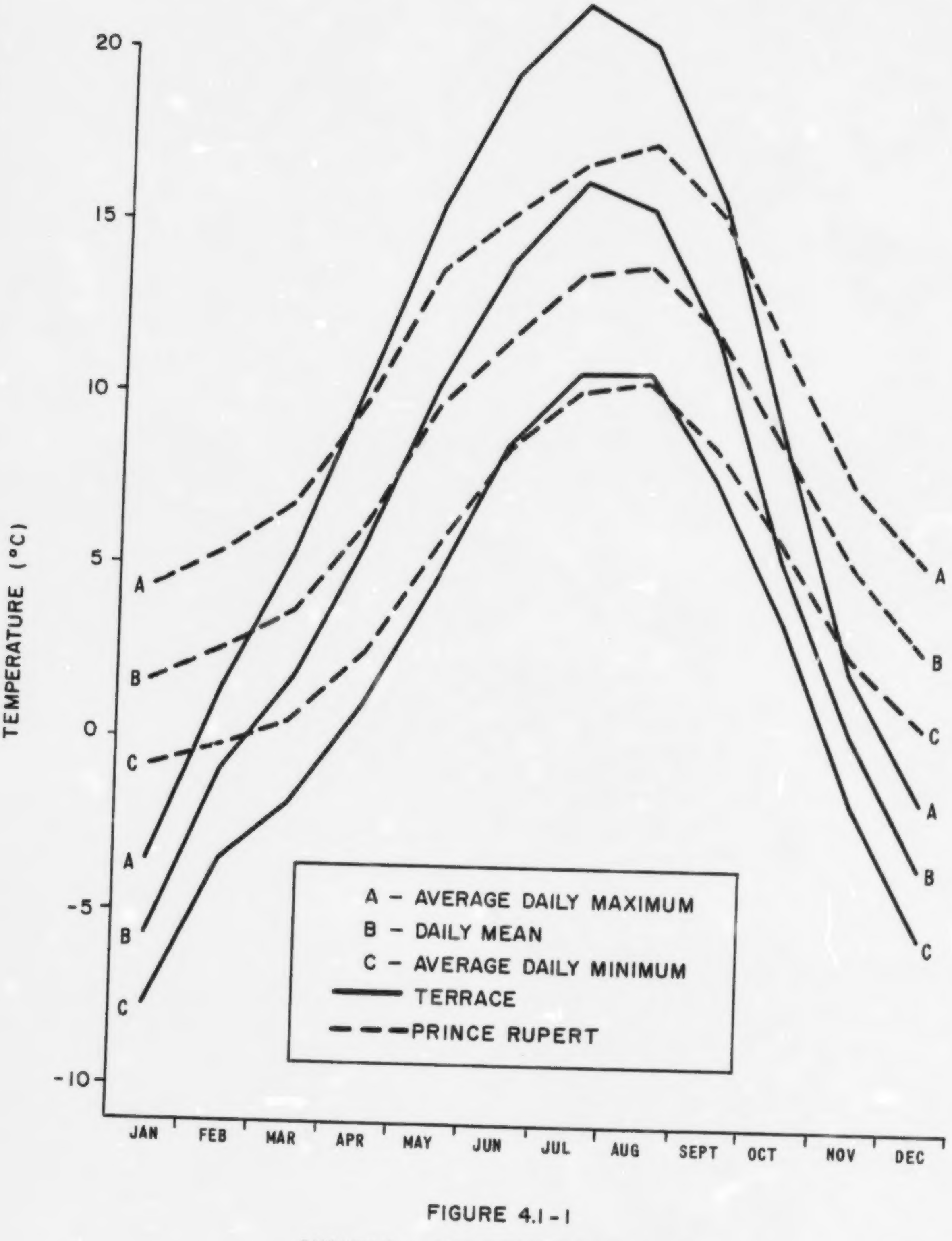


FIGURE 4.1-1

MONTHLY AIR TEMPERATURES IN TERRACE AND PRINCE RUPERT, 1951 TO 1980 (ENVIRONMENT CANADA, NO DATE) most rainfall (Fig. 4.1-2). The heavy autumn rainstorms are a significant factor in reducing slope stability, particularly in the Prince Rupert area of the valley.

Snow course data are collected at the Terrace airport, where the pattern of accumulated snow depths in 1980 was 8 cm on 1 January, 62 cm on 1 February, 16 cm on 1 March, and no snow by 1 April (B.C. Ministry of Environment 1981). There are no snow courses at higher altitudes in the lower Skeena valley, but much heavier snowfall occurs on mountains over 500 m. Due to the heavy snowfall at higher elevations and the possibility of rainfall or thaws at any time during the winter, avalanches are common in the valley. The highway between Terrace and Prince Rupert is one of three highway corridors in the province with the highest avalanche hazard rating. The highway is closed due to avalanches for an average of 13 days/year (Avalanche Task Force 1974).

(b) Hydrology

The Skeena River flows 580 km from its headwaters in the Skeena, Omineca and Hazelton Mountains and cuts through the Coast Mountains between Terrace and Prince Rupert. It drains a 42 217 km² basin above the Water Survey of Canada (WSC) gauge at Usk and an estimated 58 000 km² near its mouth at Tyee. Below Tyee the Skeena is joined by the Ecstall River from the south and empties into the Pacific Ocean, forming the 52 km² Skeena Estuary (Hoos 1976).

Data from WSC hydrometric stations are available for the Skeena River (at Usk) and seven of its major tributaries below Usk (Table A-1, Appendix A) (Water Survey of Canada, Fisheries and Environment Canada 1980). Discharge for the Skeena River within the study area was estimated from these data. The average mean annual discharge for the Skeena at Usk is 919 m^3/s, with an estimated mean annual discharge near the mouth of 1525 m^3/s. The annual flow regime of the Skeena at these two points is indicated by a plot of mean monthly discharges (Fig. 4.1-3). Low flows occur from December until early April,

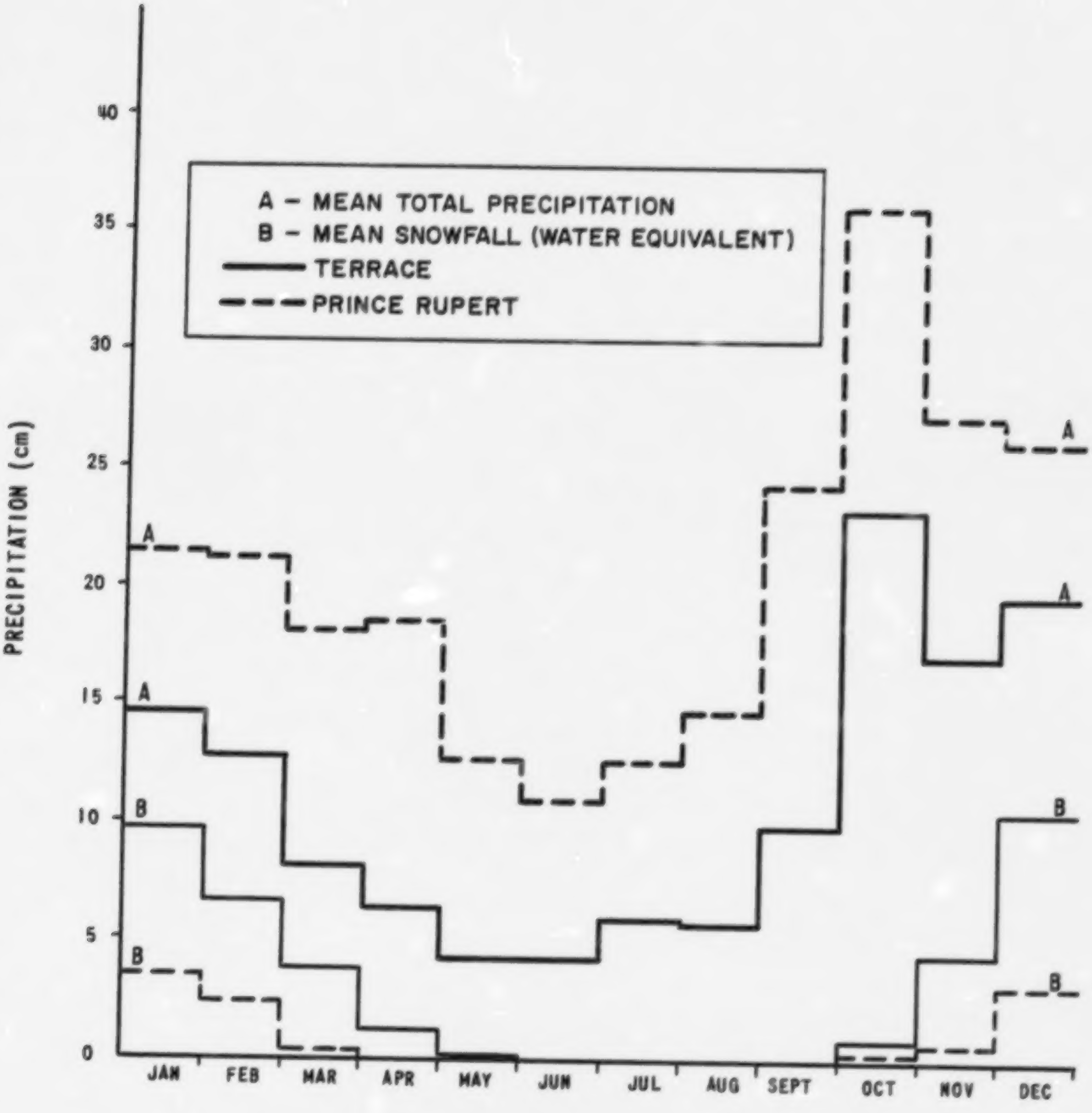


FIGURE 4.1-2

MONTHLY PRECIPITATION IN
TERRACE AND PRINCE RUPERT,
BASED ON 29 YEAR MEAN VALUES,
(ATMOSPHERIC ENVIRONMENT SERVICE, 1973b)

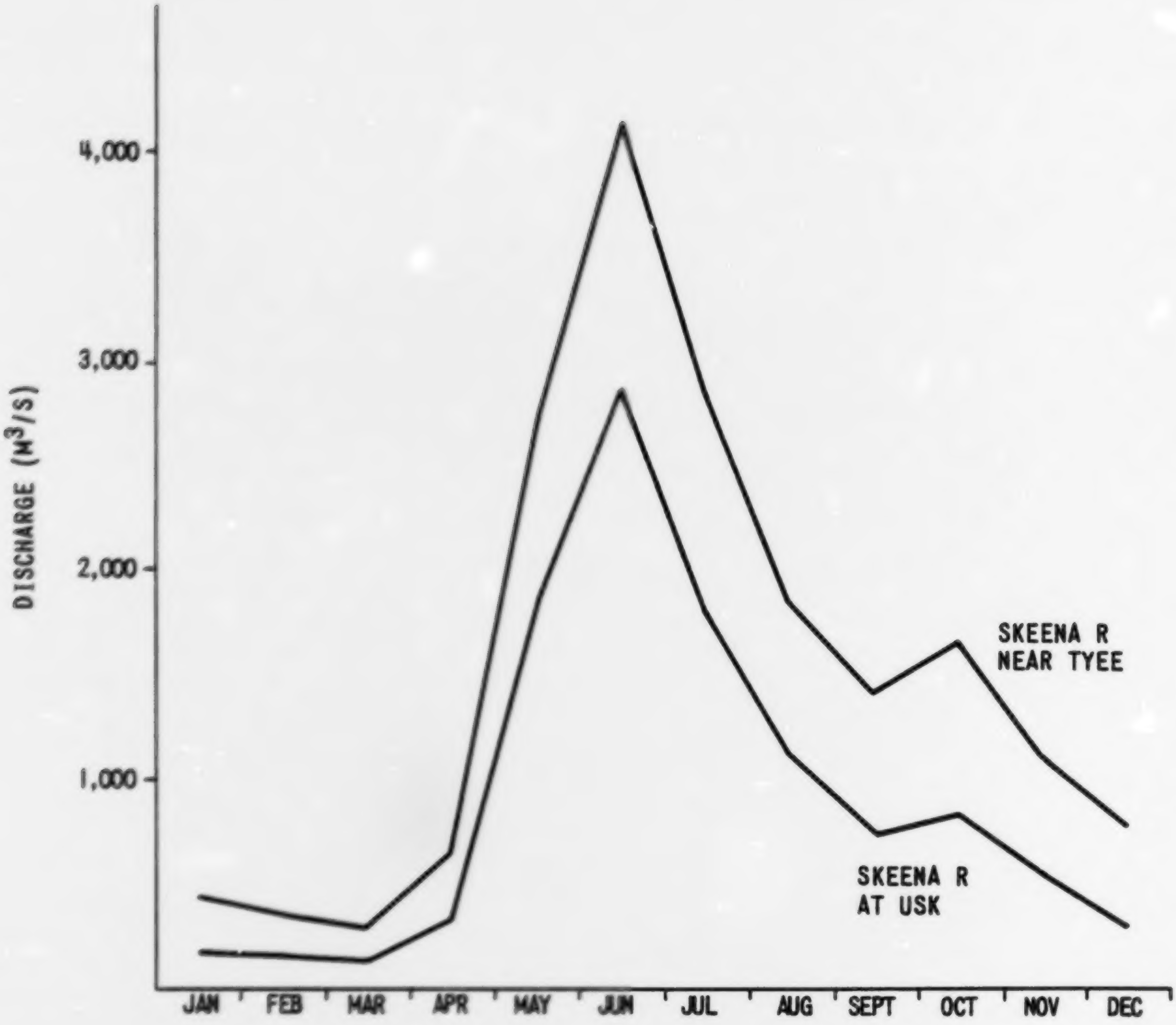


FIGURE 4.1-3

MEAN MONTHLY HYDROGRAPH, SKEENA RIVER AT USK (WATER SURVEY OF CANADA STATION #08EF001), AND DERIVED HYDROGRAPH FOR SKEENA RIVER NEAR THE MOUTH (SEE APPENDIX G).

snowmelt runoff peaks during June, glacier melt and high altitude snowmelt contributes flow during July and August and rain flood events occur in October. The latter feature is more pronounced near Prince Rupert reflecting proximity to the coastal zone where the rainfall is heavier (Fig. 4.1-2).

Maximum daily and maximum instantaneous discharges were not estimated for the Skeena River west of Terrace due to the lack of data. However, the record at Usk reveals a maximum instantaneous discharge of 8100 m^3/s, recorded on 12 June 1972, which is nine times greater than the mean annual discharge. Proportionally much higher maximum instantaneous discharges have been recorded in the lower Skeena valley, usually during fall rainstorms. For example, a maximum flow of 864 m^3/s on the Exchamsiks River was recorded on 1 November 1978, which is 20 times greater than the mean annual discharge. This is probably due to the fact that, unlike the Skeena River basin, the entire Exchamsiks River basin is exposed to heavy Coast Mountain rainstorms. The difference in flood producing events between the areas drained by these two rivers is apparent by the timing of annual peaks. Most of the annual peak flows on the Skeena occurred in the month of June, due to snowmelt or rain on snow, whereas most of the Exchamsiks River peak flows occurred in October due to rainstorms. The above comparisons were made only with data from the period of overlapping records on the two rivers, 1965 to 1979.

Spot water temperature measurements have been made by WSC (Water Survey of Canada 1977) on the Skeena River at Usk and the Exchamsiks, Zymagotitz and Zymoetz rivers gauging stations. The mainstem Skeena at Usk has 0 to 1°C readings from late November until early March, rising to a peak of 16 to 17°C in July and August and decreasing sharply from 10°C in late September to 5°C in October (Fig. 4.1-4). The stations at Zymoetz, Zymagotitz and Exchamsiks rivers have lower summer peak temperatures, with maximums of 10 to 12°C, reflecting the increased contribution of the glaciers in the Coast Mountains. The lower Skeena probably reflects the lower mid-summer temperatures of

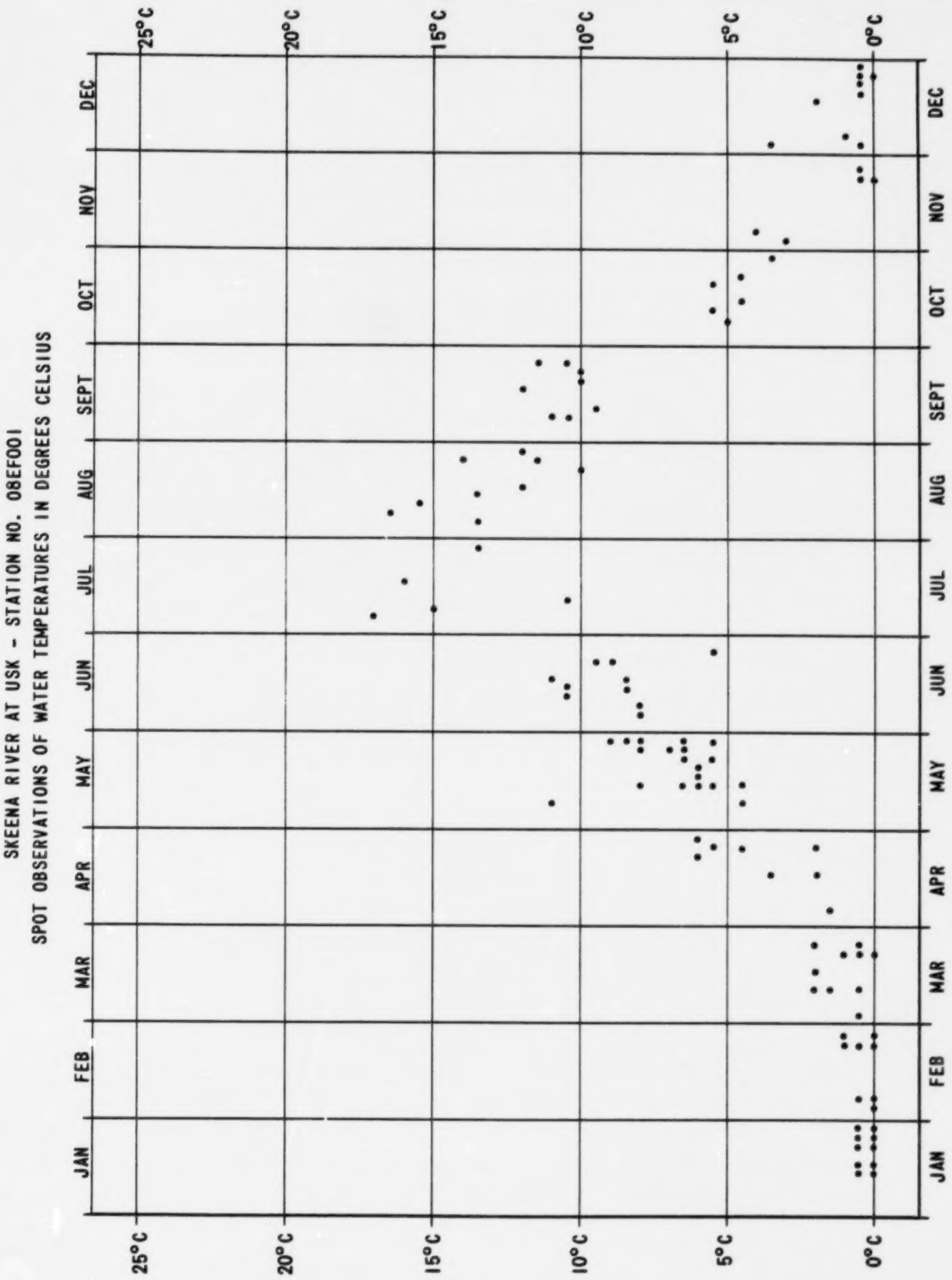


FIGURE 4.1-4

SPOT WATER TEMPERATURES (1952-1972)
SKEENA RIVER AT USK (WATER SURVEY OF CANADA, 1977b)

the Coast Mountain tributaries, but their effects will be dampened by the relatively warm water from the upper Skeena.

The winter ice regime of the lower Skeena River displays a high degree of variation. There is a 19-year (1956 to 1974) record of freeze-up and break-up dates and ice conditions for Terrace (Allen 1977). In 30 percent of the years of record, complete ice coverage was not achieved. In those years where freeze up did occur, the mean freeze-up date was 25 December and the earliest and latest dates of complete freeze-up were 20 November and 14 January respectively. Break-up dates were also variable, with the earliest, mean and latest dates being 16 February, 1 April and 28 April respectively. Conditions such as a rapid rise in spring discharge or air temperatures can cause a dynamic break-up with ice jamming and backwater flooding.

Suspended sediment concentrations are not routinely sampled on the Skeena River system, but water quality is monitored at Terrace (Inland Waters Directorate 1974). Waters of the Skeena River are of the alkaline earth bicarbonate type and are classified as soft (40 to 60 mg/l $CaCo_3$). Turbidity (10 to 35 JTU) is highest in May and June, while total dissolved solids are greatest from October to February. Transport of sediments down the Skeena River system is high, as reflected by the rapidly shifting alluvial islands in the lower reaches (Section 4.1.3).

4.1.2 PHYSIOGRAPHY AND BEDROCK GEOLOGY

(a) Physiography

The study area lies within the Kitimat Ranges of the Coast Mountains which are bounded on the east by the Hazelton Mountains and on the west by the Hecate Depression (Holland 1976). The Coast Mountains form part of the Coast Mountain Area in the Western System of the Canadian Cordillera and extend in an unbroken chain from the Fraser River into the Yukon Territory.

The Kitimat Ranges within the study area rise to more than 1900 m and their elevation decreases toward the west. They consist of eroded granitic rocks with most peaks rounded by glaciation. Exfoliation is common, resulting in bare, dome-like mountains, some with steep cliffs. Extensive lineaments have resulted from erosion of belts of less resistant sedimentary and volcanic strata within the dominantly granitic terrain.

The Skeena River is the only major river dissecting these ranges. The river is in a major U-shaped glacial valley. Numerous tributaries are also in U-shaped valleys, some of which are also hanging valleys.

(b) Bedrock Geology

The oldest rocks in the study area are gneisses, amphibolites and migmatites that are presumably of Late Paleozoic age as illustrated in Maps GM-1 to GM-7 (Hutchison 1967; Duffell and Souther 1964). The rocks lie in two north and northwest trending belts parallel to the mountain range and vary in composition from granodiorite to quartz diorite.

Near the eastern margin of the Coast Mountains, in the Skeena River valley, there are areas underlain by Carboniferous and Permian greenstone, shale, limestone and chert. The lowest part of this section consists of altered greenstone which is partly migmatized and more than 1525 m thick. The greenstone is overlain successively by approximately 300 m of argillaceous limestone with some conglomerate, 6 to 30 m of impure limestone and 15 to 30 m of white limestone. Some of these limestone lenses near Shames are mostly argillaceous, but they do contain a bluish white central bed of limestone between 23 and 30 m thick.

Also in the eastern part of the study area 300 m of clastic and volcanoclastic rocks lie unconformably over the limestones and greenstones. The unit consists of greywacke, volcanic sandstone, siltstone, chert and volcanic breccia with limestone boulder conglomerate at the base. Bedrock on Kitsumkalum Mountain, northwest of Terrace, consists of andesite breccia and tuff and some rhyolite, greywacke and argillite of the Lower Jurassic Hazelton Group.

Early Tertiary granodiorite is common in the eastern part of the study area. The valleys are infilled with Quaternary unconsolidated, fluvial and marine sands and glacial deposits; therefore, outcrops are rare.

Foliated and nonfoliated diorite, quartz diorite and granodiorite together with gabbro, norite, gneiss, migmatite and amphibolite, presumably of Late Cretaceous to Early Tertiary age, underlie most of the central part of the area.

Near Prince Rupert the Coast Plutonic Complex consists mainly of intensely folded hornblende-biotite, biotite-garnet and amphibolite gneisses. In the Tsimpsean Peninsula the units are intensely folded and metamorphic grade ranges from the almandine amphibolite facies in the east to the greenschist facies in the west. The contact with the underlying unit varies from sharp to gradual.

(c) Structural Geology

There were several periods of deformation and metamorphism throughout the geologic history of the region (Hutchison 1967; Duffell and Souther 1964). During the Early Permian the basement rocks were folded and metamorphosed. Uplift and erosion occurred at the end of the Early Jurassic and in the Late Middle Jurassic there was local folding, tilting and subsequent erosion associated with the development of the Skeena Arch. The climax of metamorphism and deformation accompanied major erosion and the beginning of emplacement of most of the Coast Range Plutonic Complex. The foliation which is evident in the field is related in part to this deformation and probably in part of the intrusion of viscous magma. Erosion has occurred almost continuously since the Eocene period.

4.1.3 SURFICIAL GEOLOGY

(a) Recent Geologic History

The entire Coast Mountain region was covered by the last major glaciation in British Columbia, commencing approximately 20 000 years ago (Fulton 1971). This event (the Fraser Glaciation) and previous glaciations shaped the strongly rounded mountains and the U-shaped and hanging valleys of the lower Skeena valley. Deglaciation of the lower valleys commenced approximately 8000 years ago. Small remnant alpine glaciers persist on summits and in cirques above 1000 m (Field 1975). Despite the extensive glacial history of the study area, glacial deposits such as till and moraines are rare. Presumably, most of these materials were washed off the steep mountains by heavy precipitation into the lower valley bottoms (Hutchison 1967).

Marine inundation of the coastal zone and the Skeena and Kitimat valleys occurred in the immediate post-glacial era, extending up to 80 km inland (Armstrong 1966). Marine sediments are found up to 150 m above sea level in the Terrace area and in the Kitsumkalum valley. The thick marine deposits of the Terrace area were deltas during the heavy glaciofluvial runoff of the deglaciation period and may exceed 10^{10} m^3 in volume (Clague and Hicock 1976). Interfingered with the marine sediments and in several of the higher tributary valleys, glaciofluvial outwash was deposited. Isostatic rebound since deglaciation is estimated to have been at least 300 m in the Kitimat-Terrace area (Armstrong 1966). As the land surface rose and the glaciers continued to retreat, extensive fluvial deposits of the Skeena River and tributaries blanketed the lower Skeena valley bottom and all older sediments. Downslope movement of sediments on steep mountainsides is accentuated by the heavy precipitation. These are the predominant processes active in the study area, in addition to the fluvial deposition and reworking of sediment by the Skeena River system.

(b) Surficial Deposits

Preliminary mapping of the terrain units in the study area at a 1:50 000 scale was done by the Resource Analysis Branch (RAB), (British Columbia Resource Analysis Branch n.d.). These maps (Maps SG-1 to SG-7) have been reproduced without modification with a legend condensed from the classification scheme described by the RAB (British Columbia Resource Analysis Branch 1978). It should be emphasized that only limited ground checking of the terrain units mapped by aerial photographic interpretation was possible due to limited access to the study area and the steep topography. As a result, the thickness and stratigraphy of surficial deposits has not been routinely field checked. The Terrace area has depths of marine deltaic sands and gravels over 150 m and drilling in the lower Skeena valley near Kwinitsa Creek encountered 65 m of clay and salty mud (Hutchison 1967). However, much of the study area has a thin overburden (generally 3 m or less), particularly on the steep valley walls. Despite the proximity of bedrock to the surface in many areas, a heavy forest cover masks the ground surface and makes aerial photograph interpretation of terrain types difficult.

On the macroscale, the study area can be broken into three units of relatively homogeneous surficial deposits: km 0 to km 34 from the Prince Rupert Substation to the Skeena River near the Khyex River confluence, km 34 to km 118 along the lower Skeena valley and km 118 to km 126 from the Lakelse River to the Skeena Substation near Terrace.

The Prince Rupert unit consists of low rounded mountain topography, heavily scoured by glaciers during the Pleistocene. Small pockets of a clayey till are found in depressions in the bedrock surface and are usually covered by deep organic deposits. Most of the morainic deposits form a veneer less than 1 m thick. A thicker morainic blanket and possibly some glaciofluvial materials deposited in the Lachmach valley are the exceptions to the generally thin covering (Tera Environment Resource Analysts 1975). The most common surficial unit in the Prince Rupert segment is a thin colluvial veneer, developed directly on the bedrock surface or on the thin glacial deposits. This colluvial material is thicker along the Kloiya River (km 3 to km 6) valley and in the Prudhomme valley to the northeast of Prudhomme Lake (km 11N to km 14N). The latter deposit has accumulated by the formation of several small colluvial fans and talus cones and coalesced into an apron below the steep rock slopes of the narrow Prudhomme valley. Mass wasting processes occur in the colluvial veneer over bedrock units particularly during fall rainstorms (Clague 1978).

Organic deposits have developed extensively and often to great depths in the Prince Rupert area due to the extremely heavy precipitation and impervious rolling bedrock topography. Depths of up to 10 m of organics have been sounded, but a veneer of less than 1 m is most common. Depending on the drainage characteristics of the site, sphagnum bogs or sedge fens have developed and the deposits are found in various stages of decomposition (fibric or mesic). Wood fragments and plant fibres are common and the lower layers have often consolidated and lithified to form peat.

Within the middle unit the recent sand, silt and gravel alluvial deposits occupy most of the valley bottom. These extensive floodplain deposits generally coarsen upriver, progressing from the silts and fine sands on the tidal flats of the Skeena estuary and Ayton and Carnation Island areas, to the sand and cobble bars of the middle river reaches up to Terrace. Silts and fine sands are deposited during overbank flooding on the high, more stable alluvial islands and the configuration of active channels and bars is shifting rapidly. High, old sections of the floodplain at river mouths are above the range of medium frequency flood events and organic deposits are developing. These are younger than and not as deep as the Prince Rupert area organics and are found at the mouths of the Khyex, Kwinitsa, Kasiks, Exchamsiks, Gitnadoix and Exstew rivers. Abandoned floodplain segments at the Exchamsiks, Exstew and Shames flats are also developing shallow organic veneers.

Steep bedrock slopes with little or no overburden, and deposits of thin colluvial veneer are also common terrain types in the middle unit. The colluvial material is primarily rubbly or angular fragments of locally derived bedrock which have been weathered from the rock surface and transported downslope by mass wasting processes. These processes include gradual movement such as creep and solifluction and rapid movement such as avalanches, rockfalls and landslides. Rainfall, particularly during the autumn and winter, contributes to the high incidence of avalanches and landslides along the Skeena valley (Clague 1978). Wide avalanche tracks of bare bedrock are common on the steep valley walls. Fans or aprons of colluvial or fluvial materials have accumulated at the base of the valley walls. Left undisturbed, these thick unconsolidated deposits are relatively stable and well drained.

The third main unit of the study area is a short 10 km section of deep, fine-grained marine sediments. These sediments were deposited during the marine inundation up the Kitimat valley in the post-glacial period. The silty clay marine sediments are susceptible to erosion and disturbance and several landslides have occurred near Lakelse Lake (Clague 1978). Gullying of the fine- grained materials is common, particularly if the surface vegetation cover is cleared or disturbed.

The western end of this unit (km 117 to km 120) consists of thick fluvial fan and terrace deposits along the Lakelse River. These sand and gravel deposits are less susceptible to disturbances than the marine sediments, and are being exploited as a local source of aggregates. Small pockets of marine sediments were found by field checking in September 1980 further west along the Skeena valley than indicated on the RAB mapping. In many places these silts and clays were buried by or interfingered with fluvial and colluvial sediments and are therefore not apparent on the air photos. Marine sediments have been found near the Shames River, Graveyard Point, Whitebottom Creek and several small tributaries near km 110S to km 111S. These findings increase the hazard risk from unstable slopes for a larger portion of the Skeena valley (approximately km 104S to km 117) than is apparent from the RAB mapping.

(c) Soils

A detailed soils map of the study area has not been produced, but common associations with the terrain units make interpretation of general soil types possible. A cross section (Fig. 4.1-5) through the Coast Mountains indicates the general soil types represented and the gradient of vegetation and climate inland (Valentine et al. 1978). Climate, topography and drainage are also important determinants of soil types and the organic soils of the Prince Rupert segment of the study area are a good example of climatically determined soils. The common organic soils are fibrisols and mesisols, depending on the depth and degree of decomposition of the plant materials. Mesisols appear to be the most common soil type in the Prince Rupert unit, indicating the dominance of sphagnum material. Mesisols have slightly better drainage and lower water table than fibrisols. They also contain nutrient-rich ground water due to the seepage from surrounding mineral soils. At high elevations along the Skeena valley, thin organic soils called folisols have developed on the bare bedrock.

Regosols have developed on the recent alluvium along the Skeena River and these shallow, poorly developed oxidized and well-drained soils are the youngest soil association in the study area. A series of buried horizons of regosolic soil development can be seen in cut banks on alluvial islands. These layers represent soil development interrupted by a flood event and the deposition of fresh alluvium. Gleysols occur on poorly drained sites where regosols would otherwise develop, on old segments of the floodplain and on low slopes of thick colluvial deposits.

On the well-drained and coarse textured colluvial and morainic parent materials, soils of the podzolic order have developed. Biologic and chemical transformations are intense in these soils due to the downward movement of water and good growing conditions for coniferous

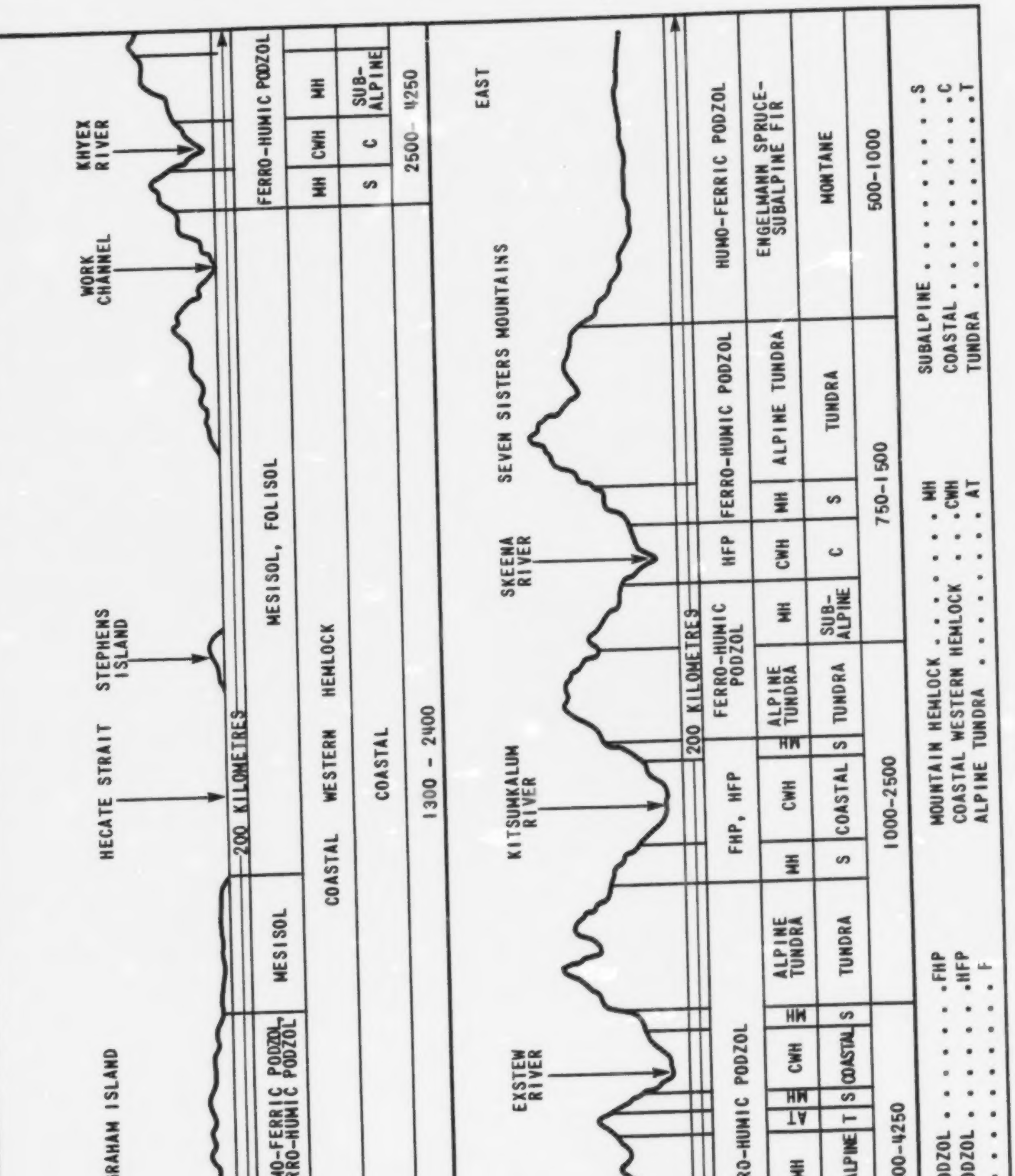

WEST
EAST
ELEVATION (METRES)
2000
1000
SEA LEVEL
GRAHAM ISLAND
HECATE STRAIT
STEPHENS ISLAND
WORK CHANNEL
KHYEX RIVER
200 KILOMETRES
SOIL LANDSCAPE
FHP
F
FHP
F
HUMO-FERRIC PODZOL, FERRO-HUMIC PODZOL
MESISOL
MESISOL, FOLISOL
FERRO-HUMIC PODZOL
BIOGEOCLIMATIC ZONE
COASTAL WESTERN HEMLOCK
MH
CWH
MH
FOREST REGION (ROWE)
COASTAL
S
C
SUB-ALPINE
PRECIPITATION (mm/yr)
1300 - 2400
2500- 4250
EXCHAMSIKS RIVER
EXSTEW RIVER
KITSUMKALUM RIVER
SKEENA RIVER
SEVEN SISTERS MOUNTAINS
FERRO-HUMIC PODZOL
FHP, HFP
FERRO-HUMIC PODZOL
HFP
FERRO-HUMIC PODZOL
HUMO-FERRIC PODZOL
AT
MH
CWH
MH
AT
MH
CWH
MH
ALPINE TUNDRA
MH
CWH
MH
ALPINE TUNDRA
MH
CWH
MH
ALPINE TUNDRA
ENGELMANN SPRUCE-SUBALPINE FIR
TUNDRA
S
C
SUBALPINE
T
S
COASTAL
S
TUNDRA
S
COASTAL
S
TUNDRA
SUB-ALPINE
C
S
TUNDRA
MONTANE
2500-4250
1000-2500
750-1500
500-1000
LEGEND
FERRO-HUMIC PODZOL . . . . FHP
HUMO-FERRIC PODZOL . . . . HFP
FIBRISOL . . . . F
MOUNTAIN HEMLOCK . . . . MH
COASTAL WESTERN HEMLOCK . . . CWH
ALPINE TUNDRA . . . . AT
SUBALPINE . . . . S
COASTAL C
TUNDRA . . . . T

FIGURE 4.1-5

CROSS-SECTION THROUGH COAST MOUNTAINS, SHOWING TYPICAL SOIL, VEGETATION AND CLIMATE ZONES (VALENTINE ET AL.1978) forests. It is the accumulation of decomposed organic matter and aluminum and iron secondary minerals in the B horizon that is the distinguishing characteristic of podzolic soils. Ferro-humic podzols (organic matter more abundant) are common under humic forest conditions to the west and humo-ferric podzols (organic matter less abundant) are more common to the east where it is cooler and drier (Valentine et al. 1978).

4.1.4 VEGETATION

(a) Objective

The objective of the vegetation inventory was to document the vegetation of the study area in sufficient detail to determine areas sensitive to disturbance.

(b) Methodology

Existing data from vegetation plot sampling were collected from the Ministry of Environment Terrestrial Studies Branch in Kelowna, and the Ministry of Forests Research Divisions in Victoria and Smithers. Personnel from those offices were interviewed to determine the status of vegetation description and mapping in the study area. A short field trip in September 1980 was made to study the vegetation types. Forest cover maps from the Ministry of Forests and Canadian Cellulose Company Ltd., and aerial photographs were used in conjunction with Terrestrial Studies Branch terrain maps to formulate generalized vegetation maps for the eastern portion of the study area. Existing mapping by Tera Environment Resource Analysts (1975) was utilized for the western portion of the study area. The vegetation types were not ground-checked in the field due to the onset of winter.

A literature review was undertaken to identify the likelihood of rare and endangered species in the study area. Botanists at the University of British Columbia were asked for further information on such species. Scientific names for all plants referred to in the text are given in Table B-1, Appendix B.

(c) Vegetation Classification

The vegetation of the study area is characterized by the communities of two biogeoclimatic zones, the Coastal Western Hemlock (CWH) zone (Krajina and Brooke 1970) and the newly proposed Coastal Cedars Pine Hemlock (CCPH) zone (Pojar 1980). Communities typical of a third zone, the Mountain Hemlock (MH) zone, occur only in isolated locations in the western portion of the study area.

The CWH zone is characterized by a temperate rainy climate and coniferous rain forest vegetation at elevations below 1000 m. It is divided into the amabilis fir-spruce and the northcoast maritime-subzones. The amabilis fir-spruce (CWHf) subzone is the drier of the two, extending westward from Terrace to a point near the Exchamsiks River. The northcoast wetter maritime (CWHi) subzone has a more coastal climate, is marked by the occurrence of yellow cypress, and extends westward from the Exchamsiks River to Aberdeen Point.

The CCPH zone occurs from sea level to approximately 600 m on the outer mountains and lowlands west of Aberdeen Point to Prince Rupert. The climate is rainy, cool and humid.

The MH zone is found on mountain slopes above 600 m in coastal areas near Prince Rupert and above 1000 m in inland areas east of Aberdeen Point. The climate is cold, subalpine and humid.

Ecosystem associations within each biogeoclimatic zone have not been precisely defined in most areas of northern British Columbia and the study area is no exception. Tentative associations have been identified within the CWH dry subzone (Pojar 1980) and the CCPH zone (Banner 1980). Broad vegetation types in the western portion of the study area, including the CCPH zone and the CWH wet subzone were described by Tera Environment Resource Analysts (1975).

In this study, the vegetation has been grouped into nine different types. Each type described below may consist of more than one ecosystem association and any number of plant communities. Table B-2 describes some of the associations and communities included in each vegetation type. Maps VG-1 to VG-7 illustrate the vegetation types found in the study area.

(i) Low-Salinity Tidal Marshes

These marshes occur along the Skeena River near the mouths of the Khyex and McNeil (Green) rivers and on Ayton and Carnation islands. Small areas also exist on the shores of Kloiya Bay and Work Channel. Tera Environment Resource Analysts (1975) described three communities which form zones in proximity to the water.

Soft mudflats at the water's edge are vegetated with waterstar and widgeon grass mats. Rare semi-aquatic species include flowering quillwort, mudwort, water plantain and wapato. Bur reed, spike rush and buttercup are common.

Tall marsh species grow adjacent to the mudflats. These include slough sedge, water hemlock, bulrush, water parsnip, bentgrass, baltic rush, sea-watch, silverweed cinquefoil, deer cabbage, speedwell and horsetail.

Shrubs such as red alder, crabapple, red huckleberry and several species of willow grow near the alluvial forest. Herbs include skunk cabbage, false lily-of-the valley, slough sedge, small-fruited bulrush, hairgrass, horsetail, bluejoint, sea-watch, beach lovage, giant vetch, aster and water parsley. Chocolate lily, a rare plant, is also present.

(ii) Bog-Muskeg

The most extensive bog areas are in the western portion of the study area, in the CCPH zone. Similar plant communities are in lesser abundance in the CWH zone. Bog areas can be either open or forested and may contain pools with aquatic plants, and hummocks or rock outcrops with plant communities of a more xeric (drier) nature. Bogs are characterized by organic blankets or veneers over bedrock or other parent materials. Soils are mostly mesisols and fibrisols. Drainage is always poor in open bogs and somewhat better in forested bogs which are often found on gentle to moderate slopes.

Trees occurring in the bogs are stunted forms of western hemlock and red cedar, plus shore pine and yellow cypress in the CCPH zone. Even in forested bog areas (either wooded islands in open bogs or as transition vegetation between open bog and closed coastal forest), trees are widely-spaced, dwarfed and grow slowly.

Common shrubs are Labrador tea, bog laurel, wild cranberry, dwarf azalea, bog blueberry, lingonberry and sweet gale. Forbs include sundews, burnet, goldthread, white gentian, starflower and skunk cabbage. Several sedges, rushes, grasses and Sphagnum mosses are found. Xeric communities include juniper, crowberry and reindeer lichens.

(iii) Coastal Forest

This is the most common vegetation type in the study area. The forests are dense with western hemlock and western red cedar as the dominant tree species. Yellow cypress is present in the CCPH zone and CWHi subzone, while amabilis fir is characteristic of both subzones of the CWH zone. In the CCPH zone, coastal forest occurs on moderate to steep slopes, while in the CWH zone it occurs on flat terrain as well as mountain slopes. Podzolic soils are typical.

Characteristic shrubs are salal, false azalea, oval-leaf huckleberry, red huckleberry and Alaska blueberry. Devil's club occurs on sites with seepage water.

Bunchberry, wintergreen, strawberry bramble, queen's cup, oak fern, deer fern, foam flower and the rare western twayblade orchid occur in this vegetation type. The mosses, Rhytidiadelphus loreus and Hylocomium splendens, are dominant. Numerous other species are abundant as well.

(iv) Alluvial Conifer Forest

Sitka spruce is the dominant tree species in this vegetation type, accompanied by western hemlock, western red cedar and red alder. Regosols, brunisols and podzols develop on mostly inactive alluvial parent materials adjacent to rivers and streams. The skunk cabbage association of the CWHf subzone is included here because of similarities in vegetative cover. The association usually develops with organic soils on a wide range of parent materials. It occurs on restricted drainage sites influenced by seepage. The alluvial conifer forest has variable drainage in upper soil horizons and the rooting zone is strongly influenced by seepage.

Devil's club is the most characteristic shrub of this vegetation type, along with salmonberry, elderberry and oval-leaf huckleberry. Black twinberry, red-osier dogwood and high-bush cranberry occur in the skunk cabbage association.

The herb layer includes lady fern, oak fern, spiny woodfern, foamflower, skunk cabbage, twisted stalk, false lily-of-the-valley, enchanter's nightshade and stream violet. Rhytidiadelphus loreus is the characteristic moss. Bryophytes and lichens are commonly found on trees and logs.

(v) Successional Communities

Much of the study area, especially along the Skeena and Lachmach valleys, has been logged. Species present in the successional vegetation type depend on soil and climate conditions and the period of time since logging took place. Early seral communities often include a large number of weedy species from nearby areas.

Plants which often appear shortly after disturbance are fireweed, bracken, horsetail, pearly everlasting, red and Sitka alders, salal, trailing bramble, elderberry and a number of grasses and sedges. Common tree species are western hemlock, western red cedar and Sitka spruce. Lodgepole pine often colonizes dry sites in the eastern parts of the study area. Cottonwood and willows colonize wet areas near rivers and streams.

These communities will gradually be replaced by communities which reflect the soils and climate of the area, i.e., coastal and alluvial forests.

(vi) Aquatic Communities

Freshwater aquatic communities occur in small ponds within the bog-muskeg vegetation type as well as lakes which support submerged or floating aquatic plants. Common water plants include yellow water lily, bladderwort, pond weed, bur reed, aquatic buttercup, coontail and bog bean. Edges of pools and lakes are suitable for amphibious rush, manna grass, cotton grass, spike rush, skunk cabbage, marsh marigold and sedges.

(vii) Black Cottonwood

This vegetation type is abundant on the flood plain of the Skeena River. Most of the river islands and deltas of converging rivers are covered with cottonwoods which withstand frequent flooding. Soil development on active alluvial parent material is regosolic although some brunisols have developed on more stable areas and gleysols have developed on poorly drained sites.

Black cottonwood is the dominant tree species and often forms pure stands on the islands. Sitka spruce and western red cedar may begin to establish on stable ground or on logs. Red osier dogwood and salmonberry are characteristic shrubs. Thimbleberry, devil's club, alder and elderberry may also occur.

Lady fern, common and meadow horsetails are characteristic in the forb layer. The forb layer communities are not floristically diverse and the moss layer is nonexistant.

(viii) Pine Forest

Pine forests occur only in the drier subzone of the CWH zone. Lodgepole pine, western hemlock and western red cedar are the major species. Lodgepole pine is also found in the forested muskeg of the CCPH zone and is known there as shore pine, usually growing in a stunted form. Pines in the CWH zone are the dominant pioneer species and may also be the climax species on dry sites.

Soils are usually well-drained podzols which have developed on variable parent materials such as moraine, lacustrine, alluvial and outwash deposits. Driest sites and pure pine stands are most likely on outwash terraces.

The shrub layer, where present, includes false azalea, big and red huckleberries. Forbs include twinflower, pipsissewa, bunchberry, western rattlesnake plantain and pink pyrola.

The rich moss layer is characterized by the bryophytes *Hylocomium splendens*, *Rhytidiadelphus triquetrus*, *Pleurozium schreberi* and both *Cladina* and *Stereocaulon* lichens.

(ix) Montane Communities

Montane or subalpine forests are dominated by mountain hemlock and amabilis fir. Yellow cypress is also common in the western part of the study area. Here montane communities occur at elevations as low as 600 m.

The dense shrub layer includes blueberry, false azalea, copperbush and Sitka mountain ash. Thin mantles of bog often cover talus slopes and rock outcrops. Subalpine meadows include a variety of grasses, sedges, forbs and low shrubs.

(d) Rare Species

Twenty-one plant species occurring in the study area are considered rare or endangered (Table B-3). An additional one, Austin's phantom orchid, has not yet been confirmed (Pojar, pers. comm.).

Seven mosses from a variety of habitats have been identified as infrequent (Schofield, pers. comm). *Bryhnia hultenii* has not been collected anywhere in British Columbia except along tributaries of the Skeena River. Like the other mosses, no sporophytes have been collected. Dissemination is slow and restricted because reproduction is vegetative. For this reason the seven mosses are considered endangered.

Two hepatics are found at very few locations in the province. *Anastrophyllum donianum* is found at high elevations in the study area.

Lepidozia sandvicensis is found in very wet areas in association with yellow cypress and shore pine.

A list of rare and endangered plants for British Columbia has been compiled by a committee chaired by R.L. Taylor. The committee has established four categories of degrees of rarity (R1-R4). Species with single or few populations (R1) the rarest ones, include flowering quillwort found in bog, aquatic or tidal areas. Species identified in several populations but only locally common are designated R2. Rare species with a scattered distribution (R3) include spiny woodfern, dwarf azalea, mudwort and wapato. Waterstar has a restricted distribution but occurs in large populations (R4).

Other species which have been identified as rare by one or more sources include white gentian, water plantain, slough sedge, chocolate lily, western twayblade and gnome plant (Table B-3).

4.1.5 WILDLIFE

(a) Methods

Inventory data were gathered from published literature, government files, interviews with government personnel, and field observations.

Field observations were made during a 10-day period in September 1980 and a 5-day period in February 1981. In both instances, the proposed route was viewed by helicopter, and selected sites were examined on the ground. Wildlife sightings, wildlife sign and habitat characteristics were recorded. Unfortunately, no snow was present in the study area in February and data on use of winter ranges by ungulates could not be collected.

In general, the study area for wildlife is represented by the broad corridor outlined on the inventory maps (Maps WL-1 to WL-7). In the wildlife discussions the term "lower Skeena" is used to refer to the Skeena watershed downstream of Terrace.

Studies focussed on collection of information that would be valuable in environmental decision-making. Primary emphasis in data collection was placed on species that are used by man, are especially sensitive to environmental disturbance, or are otherwise of concern to the public. Although the ecological significance of small birds and mammals is acknowledged, they are treated in less detail than are game species. No wildlife species designated as threatened or endangered occur in the study area (British Columbia Fish and Wildlife Branch 1971i).

Scientific names of species are given in Table C-1, Appendix C.

(b) Big Game Species

(i) Moose

Moose are present throughout the study area except west of the McNeil valley. They are most common from the Kasiks River east to Terrace. Moose are relative newcomers to the lower Skeena having moved into the area west of Terrace in the last 30 years (British Columbia Fish and Wildlife Branch 1979c). This has been part of a province-wide southward and westward range expansion of moose within the last century.

No population estimate is available for moose in the study area, but numbers are relatively low compared to some other parts of the province. The Fish and Wildlife Branch (1979c) has rated relative abundance of moose in the lower Skeena as few to very few except for the Gitnadoix valley, where abundance is rated moderate to plentiful. Nevertheless, the moose is the most abundant big game species in the area, and a major focus of habitat protection for the regional staff of the Fish and Wildlife Branch (G. Caw, pers. comm.).

The habitat requirements of moose have not been studied in coastal British Columbia, but may be generalized from studies in other areas. Forage and climate are the most important limiting factors for moose (Franzmann 1978). During summer, moose utilize a variety of habitat types where forage is abundant, such as open or early-successional forests, lakeshores and swamps. Bodies of water and shady forests are probably important in relieving heat stress. In winter the depth, density and hardness of snow limits moose to certain habitats, such as closed-canopy coniferous forests, south-facing slopes, and river valleys. Snow also reduces the amount of forage available and increases the energy required for travel (Franzmann 1978), making winter a critical season for moose in areas with heavy snow.

In the study area, only the Gitnadoix valley is rated by the Canada Land Inventory (CLI) as Class 3W, a winter range with slight limitations to moose production. From Terrace to Selma Island the valleys of the Skeena and its major tributaries are Class 4, having moderate limitations for moose. The limiting factors are climate, snow depth and in some areas, flooding. Adjacent upland areas and the Skeena valley from Selma Island to the Khyex River are Class 5 or 6, having moderately severe or severe limitations for moose production.

The Skeena valley west of Terrace is a major moose winter range. On an inventory flight in winter 1979, Fish and Wildlife Branch personnel counted 46 moose in about 60 km between Terrace and the Kasiks River (British Columbia Fish and Wildlife Branch files). Mouths of tributaries and the islands in the Skeena are heavily used. The plant communities most important as moose winter range are the black cottonwood and the devil's club - lady fern - oak fern ecosystem associations (J. Pojar, pers. comm.). Logged-over areas with abundant shrub growth are used as feeding sites. Red-osier dogwood and willow are preferred forage species, though other shrubs are also taken. Patches of coniferous timber intercept snow and provide thermal cover for wintering moose.

Because of logging and flood action, patches of large conifers are few in the valley bottom, and those that are present are heavily used by moose when winter weather is severe (G. Caw, D. Crack, pers. comm.).

Moose typically calve in dense vegetation in late May or early June, though some calving may occur later in the summer (D. Crack; A. Eadie, pers. comm.). Islands are often favoured calving sites, as predators are discouraged by water. No information is presently available on the use of specific islands in the Skeena for calving, but a study to be undertaken in 1983 will attempt to procure that information.

Most of the valley bottom in the eastern portion of the study area may be used by moose when winter weather is not extreme; this area is designated "mild-winter range" on the inventory map. Areas designated "severe-winter range" are those in which moose concentrate under adverse winter conditions. Typically, they offer a favourable combination of cover, low snow depth and forage. The presence of "severe-winter range" is probably critical to the survival of moose populations in the study area.

(ii) Deer

Deer are the most important game species in the western portion of the study area. Sitka black-tailed deer occur from approximately the Khyex River west to the coast, including the entire Tsimpsean Peninsula (R. Escott, pers. comm.). An occasional deer is found near the Terrace Substation (D. Crack, pers. comm.). These animals are in the zone of overlap between the Sitka and mule deer subspecies, and may be hybrids.

Little information is available on deer numbers in the study area. The Fish and Wildlife Branch (1980d) mapped deer abundance near the coast as moderate to plentiful, and deer abundance in the remainder of the study area as few to very few. Tera

Environment Resource Analysts (1975) estimated, on the basis of "informed guessing", that the total deer population on the Tsimpsean Peninsula and associated islands was 400 animals. The coastal population is suspected of being in decline; heavy snow winters and predation by wolves are thought to be the causes (British Columbia Fish and Wildlife Branch 1980f).

The coastal portion of the study area is rated as CLI Class 5, having moderately severe limitations for deer production. Climatic factors, snow depth and soil depth are the limiting factors cited. The remainder of the study area has no ratings for deer (Lands Directorate 1975).

Deer are not as well adapted to snow as are moose, and their limited distribution in the study area is almost certainly a result of excessive snow depth. Where deer occur, their ability to survive depends on the availability of good winter range. The critical winter ranges of these coastal deer are not fully understood. Along the immediate coastline deer utilize shallow bays and stream estuaries backed by coniferous forests. The animals use the coastal forest fringe for cover, and feed on forest litterfall and on marine plants along the foreshore (Tera Environmental Resource Analysts 1975, J. Pojar, pers. comm.). This pattern of habitat use is similar to that described for Sitka deer in southeastern Alaska (Wallmo and Schoen 1979). In parts of the Alaska coast, deer also use closed-canopy coniferous forests away from saltwater, providing that snow-depths are not too great. Tsimpsean Peninsula deer may also have inland winter ranges that are used under mild conditions but these ranges have not been identified.

(iii) Mountain Goat

Mountain goats are present in suitable habitat throughout the lower Skeena watershed, except on the Tsimpsean Peninsula.

The Skeena Resource Management Region, encompassing all of northwestern British Columbia, is estimated by the Fish and Wildlife Branch to have more than a quarter of the world population of mountain goats. Mountain goat abundance in the lower Skeena watershed is rated few to very few near the coast, and moderate to plentiful inland (British Columbia Fish and Wildlife Branch 1979d). Goat populations are believed to be declining in much of the lower Skeena area. This is thought to be due to increased accessibility for hunters via new logging roads (British Columbia Fish and Wildlife Branch 1980f). Goats are extremely vulnerable to overhunting and to harassment from humans, especially in winter. Predation is not thought to be important in limiting most goat populations (British Columbia Fish and Wildlife Branch 1979d).

Small areas of CLI Classes 3, 3W and 4 habitat occur in the mountains throughout the lower Skeena watershed; these sites have slight or moderate limitations to goat production. The factors cited as limiting goat production are climate, excessive snow depth, and inadequate soil depth (Lands Directorate 1975).

For goats, the carrying capacity of a watershed is limited by the quality and quantity of available winter habitat. Steep, rocky bluffs provide essential escape terrain and snowfree slopes. Adjacent, moderately sloped areas are used for feeding. In high snowfall areas such as the lower Skeena, the best winter ranges have a mature forest canopy overhanging steep bluffs; the trees provide shelter and intercept snow (British Columbia Fish and Wildlife Branch 1979d; Hebert and Turnbull 1977).

Because of the goat's extreme vulnerability to overhunting and harassment, specific locations of populations are not indicated on the inventory maps. Locations are considered in determining sensitivity and impact (Section 5.0).

(iv) Bear

Two bear species - the grizzly and the black - occur in the study area. Grizzly bear abundance is moderate to plentiful throughout the lower Skeena watershed except on the Tsimpsean Peninsula, where abundance is few to very few (British Columbia Fish and Wildlife Branch 1979b). Grizzly bears are present on the Tsimpsean Peninsula mainly as fall transients (Tera Environment Resource Analysts 1975). Black bears are common throughout the study area. Tera Environment Resource Analysts (1975) estimated the black bear population of the Tsimpsean Peninsula and associated islands at about 400 individuals. Black bears in the study area belong to a subspecies (*Ursus americanus kermodei*) in which the white colour phase is relatively common; white individuals are known as Kermode bears (Cowan and Guiget 1965).

Habitat use by bears is closely related to food supply except during the winter denning period. Bears are omnivorous, and feed on a wide variety of plant and animal foods. As predators they are inefficient; the major animal foods in the diet of coastal bears are carrion, newborn ungulates, salmon and marine invertebrates (Cowan and Guiget 1965). Bears are also attracted to garbage.

Bears may be found in nearly any habitat in the study area, but seasonal concentrations occur where food is abundant (G. Caw, J. Pojar, B. Wilkes, pers. comm.). In spring, vegetated slides and valley bottoms are areas attractive to bears. Skunk cabbage is a favourite spring food in the skunk cabbage ecosystem association, and horsetails are important in the black cottonwood ecosystem association (J. Pojar, pers. comm.). In June, there is probably some opportunistic predation on newborn deer and moose, but plant materials continue to dominate the diet. Berries are heavily used from mid- summer through fall. Habitat types with berry-producing shrubs, such as alpine areas, muskegs, some clearcuts and some forests are important during this period. During the salmon run black bears and grizzlies concentrate near rivers and streams. Tera Environment Resource Analysts (1975) noted that stream estuaries on the Tsimpsean Peninsula were especially important to black bears as they met most of the bear's seasonal needs for plant and animal foods.

(v) Wolf

Wolves are present throughout the study area. The Fish and Wildlife Branch rated wolf abundance as moderate to plentiful along the coast and in the Skeena valley. Wolf abundance in adjacent mountains was rated few to very few (British Columbia Fish and Wildlife Branch 1979h).

Wolf numbers in the study area increased over the last two decades, but may be declining now. In 1961, a broad-based predator control program was terminated, and wolf numbers began to increase in central and northern British Columbia (British Columbia Fish and Wildlife Branch 1979h). The spread of moose to the lower Skeena valley improved the potential of the area to support wolves. In the early 1970's there was a "remarkable increase" in wolf numbers on the Tsimpsean Peninsula and adjacent islands (Tera Environment Resource Analysts 1975). Since then, numbers may have begun to decrease. The Fish and Wildlife Branch (British Columbia Fish and Wildlife Branch 1980f) reported indications of a population decline in most parts of the Skeena Resource Management Region over the last 2 years. Wolves are still relatively common in the study area and wolf tracks were seen on several occasions during field studies in September.

In general, the habitat in which wolves are found is the same as the habitat of their major prey species, moose and deer. Population levels of wolves are related to population levels of major prey, but the relationship is not simple. When major prey species are low in numbers or difficult to hunt, alternate prey may sustain wolf populations (Connolly 1978). When alternate prey is also scarce, disease, parasites, intraspecific fighting and starvation will lead to mortality (British Columbia Fish and Wildlife Branch 1979h).

The major prey in the study area are deer near the coast, and moose further inland. Several alternate prey species are available, including beavers and other small mammals, fish, and intertidal organisms (Tera Environmental Resource Analysts 1975; British Columbia Fish and Wildlife 1979h). The presence of these species probably buffers the relationship between ungulate populations and wolf numbers.

(vi) Cougar

Cougar are extremely rare in the study area and are neither hunted nor trapped. The lower Skeena valley is located at the extreme northwestern edge of the cougar's range in British Columbia (Cowan and Guiget 1965; British Columbia Fish and Wildlife Branch 1980b).

(c) Furbearers

Twelve species commonly considered furbearers occur in the study area. [Wolves can also be considered furbearers but have been discussed in this report under 4.1.5(b), Big Game Species]. These include six species of mustelid, one felid, two canids and three rodents.

Habitats vary among the six mustelids in the study area. The marten inhabits mature coniferous forests and avoids cleared or burned areas. Mixed coniferous-deciduous forests are the preferred habitat of the fisher. The short-tailed weasel uses a variety of low-elevation habitats, especially deciduous forests. The mink, which is semi-aquatic, prefers marshes, waterways, seacoast and adjacent forests. The otter is restricted to rivers and the seacoast. The wolverine prefers subalpine forest and alpine tundra and hence is uncommon in the study area (British Columbia Fish and Wildlife Branch 1979f; Cowan and Guiget 1965).

Although literature reports that the Canada lynx only occurs east of the coast range, it is trapped occasionally between Terrace and the Exstew River. The snowshoe hare, its major prey, also enters the extreme east of the study area. Lynx occurrence in the lower Skeena valley is probably associated with peaks in the population cycle of hares (British Columbia Fish and Wildlife Branch 1963 to 1979, 1979j; Cowan and Guiget 1965).

The coyote is uncommon in the study area, especially near the coast. It is typically an animal of prairies, parkland and other open areas. The red fox is also rare or absent near the coast, but is apparently more common in the eastern portion of the study area than is the coyote. The fox prefers forest edges and riverbanks and, like the coyote, adapts well to civilization (British Columbia Fish and Wildlife Branch 1980c, 1980e).

The beaver and the muskrat both inhabit lakes, ponds and other wetlands. The beaver creates habitat by damming streams, and the muskrat often benefits from the ponds. Signs of beaver are common in wetlands along the lower Skeena valley. Muskrats are present throughout the study area, but are not as abundant as beavers (British Columbia Fish and Wildlife Branch 1979a, 1979e; Cowan and Guiget 1965).

Red squirrels are common. They inhabit a variety of forest types, but do best in mature forests of mixed conifers (British Columbia Fish and Wildlife Branch 1980e).

(d) Marine Mammals

The hair seal (harbour seal) occurs in the Skeena and in some of its large tributaries, including the Gitnadoix and Lakelse rivers. It is often sighted in the river during the salmon run and may become resident in lakes such as the Lakelse (Cowan and Guiget 1965).

(e) Small Mammals

Seventeen species of small mammals occur in the study area: three shrews, five bats and nine rodents (Cowan and Guiget 1965). These mammals are important to the ecosystems and are part of the food chain that supports larger mammals and birds.

(f) Waterfowl

Portions of the study area are important as spring, fall or winter habitat for geese, ducks and swans. Upriver of tidal effects (east of Kwinitsa) wetlands freeze over in winter, and are used primarily by spring and fall migrants. The Skeena estuary and the mouth of the Khyex River are used by wintering waterfowl as well as migrants.

Most of the rivers and wetlands in the study area were rated by the Canada Land Inventory (Canada Department of the Environment 1972a) as Class 6, having severe limitations to the production of waterfowl. The limiting factors cited were excessive water-flow, which inhibits marsh development; excessive fluctuation of water level; and inadequate soil depth for suitable plant communities. Three areas - the Shames flats, the mouth of the Exstew River and the Salvus flats, were mapped as important migration or wintering areas. Field observations and reports of local residents suggest that some areas, such as the Khyex River mouth and the Ayton Islands, were under-rated by CLI.

Canada geese are present as spring and fall migrants in wetlands throughout the study area, although the largest concentrations have been observed in estuarine mudflats (British Columbia Fish and Wildlife Branch 1977). Canada geese winter in the Skeena and Khyex estuaries, and a small number are breeding residents (British Columbia Fish and Wildlife Branch 1977). Tera Environment Resource Analysts (1975) reported that geese nested in muskeg, and there have been some reports of geese nesting along the Skeena (J. Pojar, pers. comm.).

Whitefronted geese have been observed in marshes along the lower Skeena during migration periods (Tera Environment Resource Analysts 1975). Snow geese may also be transient in the study area.

The study area includes spring, fall and winter habitat for a variety of dabbling ducks (subfamily Anatinae), which feed in shallow water; bay ducks (subfamily Aythyinae), which dive for food in deeper water; and fish-eating mergansers (subfamily Merginae). Sea ducks (subfamily Aythyinae) which are usually found further from land than bay ducks, are sometimes seen in the lower Skeena estuary.

Migrant dabbling ducks which have been reported in the study area include mallard, pintail, green-winged teal, shoveller and American widgeon (D. Crack, R. Escott, pers. comm.). The study area is also within the migratory range of the blue-winged teal (Robbins et al. 1966). Groups of several hundred dabbling ducks have been observed in spring and fall in the Skeena estuary (Tera Environment Resource Analysts 1975; Bustard 1977). Migrant dabblers are also common in freshwater wetlands further upriver. Some dabblers winter in the lower Skeena estuary (Tera Environment Resource Analysts 1975; British Columbia Fish and Wildlife Branch 1977). Mallards nest in freshwater marshes along the Skeena.

Bay ducks are present in the study area in winter and as migrants (Munro and Cowan 1947; Tera Environment Resource Analysts 1975; British Columbia Fish and Wildlife Branch 1977). Species observed include scaup (probably both species), goldeneye (probably both species) and bufflehead. Bay ducks utilize mainly the lower Skeena estuary, though scaups were observed at the mouth of Feak Creek during September field studies.

Sea ducks characteristically utilize coastal rather than estuarine habitats, but scoters are sometimes observed in the Skeena River near Tyee (B. Wilkes, pers. comm.).

Mergansers occur along waterways throughout the study area. Some common mergansers nest in freshwater marshes (Tera Environment Resource Analysts 1975), and red-breasted mergansers are probably present along the coast in winter (Munro and Cowan 1947; Robbins et al. 1966).

Trumpeter swans winter within the study area in several tributaries of the Skeena (D. Crack, R. Escott, K. Hodson, pers. comm.). In February 1981, eight trumpeter swans were observed near the mouth of the Exstew River and approximately 30 were observed in the Kasiks River delta. The trumpeter swan, though not endangered, is low in numbers, and has suffered from destruction of its habitat. It has a low reproductive potential and is therefore slow to recover from losses. Populations, once considered "dangerously low", are now believed to be increasing (Guiget 1967; British Columbia Fish and Wildlife Branch 1979i).

On Maps WL-1 to WL-7 only areas which attract migratory or wintering waterfowl in numbers are designated "waterfowl habitat". Other areas mapped as "wetlands" may also support a few birds. In addition, scattered pairs or individuals of some species occur throughout the study area along waterways or in muskeg. Areas where trumpeter swans have been reported are designated on the inventory map; these labels refer to broad areas such as tributary valleys, not to specific localities.

(g) Upland Game Birds

Upland game birds present in the study area include blue grouse, ruffed grouse and band-tailed pigeon. Ptarmigan are present at high elevations in adjacent mountains, but are unlikely to occur at the elevation of the proposed transmission line.

Blue grouse nest in forest openings and winter in high elevation coniferous forests. Their numbers often increase following logging, because breeding habitat has been created. Ruffed grouse utilize mainly deciduous and mixed forests, including riparian sites, but use conifers for shelter (Godfrey 1966; Guiget 1973). Neither species is abundant in the Tsimpsean Peninsula area (Tera Environment Resource Analysts 1975).

In summer band-tailed pigeons breed in the study area. They are common near the coast but rare upriver. They nest in coniferous or deciduous trees (Guiget 1973).

(h) Non-game Birds

Tera Environment Resource Analysts (1975) estimated from the literature and field observations that 86 bird species occurred in the Prince Rupert area, but added that further study would reveal more. Species variety in the Skeena valley study area is probably slightly lower, as the addition of species occurring in inland habitats would not offset the absence of pelagic and coast littoral species.

Bald eagles are common in the study area. During the eulachon run in late March and early April, eagles and gulls concentrate along the Skeena below Selma Island. The Prince Rupert Naturalist Club has counted as many as 203 bald eagles in one day between Tyee and Kwinitsa, a distance of approximately 32 km (B. Wilkes, pers. comm.).

(i) Reptiles and Amphibians

The study area is within the range of only two reptiles - the common garter snake and the western terrestrial garter snake (British Columbia Fish and Wildlife Branch 1979g). These harmless snakes are found along the shores of lakes, streams and the seacoast (Carl 1968).

At least four amphibian species occur in the study area: the brown salamander, the northern roughskin newt, the spotted frog and the boreal toad. Several other species have been found near the study area, and may occur there. In general, amphibians are found in damp places near water. The spotted frog lives in swamps, lakes or streams. The other species occur in moist terrestrial habitats, and return to water for breeding (British Columbia Fish and Wildlife Branch 1980a).

4.1.6 AQUATIC RESOURCES

(a) Introduction and Methods

In British Columbia the Skeena River system is second only to the Fraser River as a producer of salmonid fish (Hoos 1976). Commercial landings of salmonids in the Skeena River have averaged 1.7 million fish annually in the last decade. A significant portion of these fish originate in the study area.

The study area includes 30 fishbearing streams and lakes. The streams range in size from the large, multi-channelled mainstem of the Skeena River to short, mountain creeks with a few hundred metres of moderate gradient habitat near the mouth.

The most important aquatic resources from a social and economic standpoint are the anadromous (sea-run) salmonid fishes. Virtually all waterbodies along the route support one or more of the following anadromous species: pink (Oncorhynchus gorbuscha), chum (O. keta), sockeye (*O. nerka*), chinook (*O. tshawytscha*) and coho (*O. kisutch*) salmon; steelhead (*Salmo gairdneri*) and cutthroat (*S. clarki clarki*) trout; and the Dolly Varden char (*Salvelinus malma*). Eulachon (*Thaleichthys pacificus*) spawn in the Skeena mainstem between the Kasiks and Scotia rivers, and in the lower reaches of Kwinitsa Creek and the Scotia and Khyex rivers (J. Hipp, pers. comm.). The common freshwater fish species in the study area are the resident rainbow trout (*Salmo gairdneri*), Rocky Mountain whitefish (*Prosopium williamsoni*), northern squawfish (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), peamouth chub (*Mylocheilus caurinus*), three-spine stickleback (*Gasterosteus aculeatus*) and the prickly sculpin (*Cottus asper*) (Hoos 1976).

The anadromous salmonid populations are the focus of the aquatic resources section of this report because of their sensitivity to environmental change and importance to commercial, sport and native food fisheries. Sources of information included:

1. Field surveys conducted during August to December 1980 to document stream habitat and salmon spawning distribution along the proposed routes.

2. Government resource agency staff.

3. Unpublished data from Canada Department of Fisheries and Oceans, British Columbia Fish and Wildlife Branch and Ministry of the Environment Resource Analysis Branch.

4. Published scientific literature.

Details of study methods and findings are presented in Appendix D.

(b) Salmonid Life Histories and Distribution

Most streams in the study area, including the Skeena River mainstem, support salmonid spawning and juvenile rearing. The Skeena mainstem is also the migration route for the large, anadromous salmonid populations which spawn in the upper Skeena system.

The life history and distribution of each anadromous salmonid species in the study area is outlined below. The distribution of salmonid spawning and rearing is presented on Maps AQ-1 to AQ-7.

(i) Pink Salmon

Pink salmon are the most abundant salmonid, spawning in 15 study area streams and at approximately 30 areas in the Skeena mainstem below the Lakelse River confluence. The largest spawning populations are in the Lakelse River and the mainstem Skeena River (Plate 4.1-1).

Pink spawning occurs in August and September. Juvenile pinks have no freshwater rearing requirement and the fry migrate seaward immediately after emergence from the gravel in April and May (Higgins and Schouwenburg 1973). Pink salmon mature and return to spawn after 2 years of ocean rearing. Study area streams support both odd-year and even-year populations.

(ii) Chum Salmon

Chum salmon spawn in 12 study area streams and at approximately 15 sites in the Skeena mainstem below the Lakelse River confluence. They are not particularly abundant at any one spawning area. The principal populations downstream of the proposed routes utilize the Skeena mainstem and Shames and Exstew sloughs, side channels of the Skeena River. Many of the chum spawning sites in the mainstem are blind, cut-off channels fed by groundwater seepage (Plate 4.1-2).

PLATE 4.1-1

Important pink salmon spawning area on Skeena River above Exstew River. Looking downstream on Skeena River, the spawning area is located along lower half of bar in the middle of the photograph.

PLATE 4.1-2

Seepage-fed channel typical of chum salmon spawning areas in the Skeena River mainstem. This is a spawning site below the Exstew River, near km 95S.

Chums spawn during August and September. The available information indicates that chum fry emerge and migrate seaward in May. Like pink salmon, chum fry apparently have little or no freshwater rearing requirement. However, chum juveniles rear in the Skeena River estuary until August, about 6 weeks longer than pink salmon (Higgins and Schouwenburg 1973).

Skeena River chum salmon mature at 3 to 5 years of age, with age 4 predominating (Bilton et al. 1967).

(iii) Chinook Salmon

Chinook salmon spawn in only four areas within the study area: the Skeena River mainstem, the Kloiya River and in Diana and Prudhomme creeks near Prince Rupert. Spawning takes place from mid-August through September and the fry emerge in early spring. Analyses of adult scales indicate that Skeena system chinook are about equally represented by fish which migrate to sea as juveniles within months of fry emergence and those which rear in freshwater for one full year before seaward migration (Godfrey 1968). Investigations by Department of Fisheries and Oceans personnel have shown that from late summer through winter underyearling chinook rear in the side channels and sloughs of the Skeena mainstem below Terrace, preparatory to seaward migration the following spring (G. Berezay, pers. comm.).

Skeena River chinook return to spawn at 2 to 6 years of age; fish of ages 4 and 5 predominate in the escapement.

(iv) Coho Salmon

Coho salmon are the most widely distributed of the anadromous salmonids in the study area. With the exception of the Skeena mainstem, coho spawn in all streams which are accessible and contain suitable spawning habitat. The most important coho salmon watercourses in the study area are the Lakelse, Gitnadoix and Kloiya-Diana system. Spawning takes place from October to December, generally in the upper reaches of study area streams. Coho fry disperse widely to rear in areas downstream, sometimes entering minor tributaries to the Skeena mainstem which have no spawning population (S. Kriegl, pers. comm.).

The majority of coho in the Skeena River system mature at age 3 or 4, after rearing for either 1 or 2 years in freshwater and 2 years in the ocean (Canada Department of Fisheries and Oceans, unpublished data).

(v) Sockeye Salmon

As sockeye salmon require a lake or slough environment for juvenile rearing, spawning normally takes place in the inlets or outlets of lakes or in groundwater-fed alluvial fans within lakes. Most sockeye spawning occurs in September (Foerster 1968). Sockeye fry emerge in April or May and migrate to the lake to rear for 1 or more years. For most Skeena River sockeye populations the peak of the seaward migrant smolt run occurs in May (Foerster 1968). The majority of Skeena sockeye mature at age 4 or 5 after spending 1 year in freshwater and either 3 or 4 years in the ocean (Foskett 1956).

In the study area, sockeye populations of significance are found only at Lakelse Lake (Williams and Scully creeks), Alastair Lake at the head of the Gitnadoix River system, and at Prudhomme Lake (Diana and Prudhomme creeks) on the Kloiya River system near Prince Rupert. A minor population of under 100 spawners utilizes Esker Slough, a tributary to the north side of the Skeena River 4 km east of the Exstew River.

(vi) Steelhead Trout

Steelhead, the anadromous rainbow trout, spawn and rear in most of the large streams of the study area. Analysis of scale samples from the nearby Zymoetz and Clore rivers steelhead populations indicates that juvenile steelhead rear in the stream for 3 or 4 years before migrating to sea (Chudyk and Whately 1980). Mature adults are most commonly 5 or 6 years of age, having spent 2 or 3 years in the ocean before returning to spawn for the first time. Steelhead spawning for the second or third time were more common than usual, comprising 25 percent of the angling catch in these rivers.

The seasonal timing of adult steelhead migration into study area streams is not well documented and varies from stream to stream. Fall and early winter runs (September to December) and spring runs (March to May) are known to occur. Spawning generally takes place in May (J. Culp, pers. comm.).

Angling statistics show that the Lakelse and Kloiya rivers account for 82 percent and 14 percent respectively of the study area steelhead catch (British Columbia Fish and Wildlife Branch 1973 - 1978). Lachmach River, Kwinitsa Creek and the relatively inaccessible Exstew, Kasiks, Khyex, Exchamsiks and Gitnadoix rivers produce small and less consistent catches of steelhead from year to year. Due to good angling opportunities on the accessible rivers near Terrace and Prince Rupert, the pressure on less accessible streams, which must be reached by boat, is extremely light. Hence the catch statistics for such streams do not truly reflect the abundance of steelhead.

(vii) Cutthroat Trout and Dolly Varden Char

Cutthroat trout and Dolly Varden char are known to be present in 11 and 15 study area streams respectively. Their life histories in the study area have not been documented. On their upstream migration into spawning streams in late summer and fall, the adults of both species attract considerable angling pressure throughout the Skeena mainstem and in the lower reaches of the larger study area streams (D. Crack, pers. comm.). Dolly Varden spawn in the fall, whereas cutthroat are spring spawners. Based on studies of southeast Alaska populations (Armstrong 1970, 1971), the juveniles of both species could be expected to rear in freshwater for 2 to 4 years before migrating seaward.

(c) Abundance of Study Area Salmonids

(i) Salmon

The proposed transmission line routes cross Skeena River tributaries near their confluence with the main river and, in most cases, downstream of any salmon spawning areas. However, a significant amount of salmon spawning also occurs within the study area, in the Skeena mainstem and in streams draining into Morse Basin and Work Channel, north of the Skeena River.

Table 4.1-1 presents the estimated mean escapement of each salmon species to spawning areas within the overall study area. On average an estimated 126 000 salmon spawn within the study area each year. A major portion of study area pink (74 percent) and chinook (68 percent) salmon spawning takes place in the Skeena River mainstem (Maps AQ-1 to AQ-7). Although the salmonid rearing potential of the mainstem has received little attention the mainstem appears likely to be an important rearing area for chinook and coho salmon as well as steelhead and cutthroat trout. As noted earlier in this section, chinook rearing has been documented at a number of sites throughout the lower Skeena River.

TABLE 4.1-1

ESTIMATED MEAN SALMON ESCAPEMENTS TO SPAWNING AREAS WITHIN THE OVERALL STUDY AREA*[1]

Salmon Species	Mean Escapement	Principal Spawning Areas and Percent of Mean Escapement to Each Area
Pink	111 700*[2]	Skeena River mainstem (74%); Lakelse River (17%)
Chum	5 800	Lachmach River (57%); Kloiya River (18%); Skeena River mainstem (20%)
Sockeye	3 700	Diana and Prudhomme creeks (97%)
Chinook	2 000*[2]	Skeena River mainstem (68%); Kloiya-Diana system (32%)
Coho	2 500	Kloiya-Diana system (81%); Lachmach River (19%)
TOTAL	125 700	

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*[1] From Canada Department of Fisheries and Oceans, Annual Reports of Salmon Streams and Spawning Grounds, 1950 to 1979. Salmon escapement estimates include only those populations, or proportions of populations, which spawn downstream of or adjacent to the proposed transmission line routes. Appendix D-2 presents escapement data for individual stream systems and comments on spawning distribution relative to the transmission line routes.

*[2] Includes an unknown portion of Skeena mainstem spawning upstream of the study area. This portion is judged to be relatively small in the case of pink salmon and relatively large in the case of chinook salmon (J. Hipp, pers. comm.).

(ii) Trout and Char

There are no quantitative data on the populations of trout (Salmo sp.) and Dolly Varden char which utilize study area streams and lakes. Steelhead angling harvest statistics show that during the 5-year period 1973 to 1978 the total annual catch from the Kloiya and Lachmach rivers and tributaries entering the Skeena within the study area averaged 659 fish (British Columbia Fish and Wildlife Branch 1973 - 1978). In this same period an average of 1208 steelhead were caught annually in the mainstem Skeena River downstream of Terrace. Most of the steelhead were likely destined for spawning streams in the upper Skeena system (M. Lough, pers. comm.).

(d) Resource Enhancement

Within the study area, salmonid resource enhancement has been confined to the Kloiya River and its tributary, Diana Creek, near Prince Rupert. During 1979 and 1980 a 50 000 egg incubation facility has been operated on each of these streams as a pilot project to test the feasibility of enhancing the chinook and coho salmon stocks (D. Lawseth, pers. comm.). The project has been a joint endeavor of the Department of Fisheries and Oceans and the Northern Trollers Association. Tentative plans have been developed by the Department for a 250 000 smolt chinook and coho hatchery on the Kloiya-Diana system.

SUB-SECTION 4.2 - RESOURCE USE

4.2.1 AGRICULTURE

(a) Methodology

Canada Land Inventory (CLI) maps and Agricultural Land Reserve (ALR) maps provided the bases for agricultural capability determination. A field trip involving helicopter and ground inspection was also conducted. One commercial farm lies along a proposed route. The farmer was interviewed on site. Additional information on present and potential agriculture and grazing was obtained from G. Johnstone, Ministry of Agriculture and L. Wilson, Ministry of Forests, Smithers.

(b) Capability

Most of the alluvial flats along the Skeena River between Terrace and the Scotia River have soils and climate conducive to agriculture. Soils of the highest capability classification in the study area are located on the flats at Salvus, east of the Exchamsiks River and near Exstew (Canada Department of the Environment n.d.). These are rated CLI Class 2. The District Agriculturist reports that the flats near Shames (CLI Class 3) are also Class 2 in capability based on the range of vegetable crops grown there in past years which includes corn, zuccini, and a wide range of cool season crops. Some difficulty has been encountered growing cucumbers. Class 2 lands can produce a wide range of crops. The main crop production constraints in the study area are the high water table at certain times of the year and less than optimal mean daily summer temperatures. At times a moisture limitation due to rapid drainage of the soils must be corrected by irrigation (Canada Department of the Environment 1972a).

Many of the islands are considered Class 3. They are restricted in capability largely due to the wetness caused by the high water table.

Most of the islands are flooded periodically during the summer and fall.

Some land east of Dasque Creek and near Alwyn Creek is rated Classes 2 to 4. It is limited by its clay texture which makes tillage and root penetration difficult. Other land in the area is non-arable (Class 5) but is considered suitable for grazing.

Topography, stoniness and shallow soil depth are limitations in most of the non-agricultural parts of the study area.

(c) Present Use and Development Potential

The only present agricultural production of significance within the transmission routes is located at Shames. A recent vegetable operation appears viable and the landowner is expanding to meet the demand for fresh vegetables from Prince Rupert residents who constitute 90 percent of his market. The policy of the Ministry of Agriculture is to develop the vegetable industry in this area. Several small hobby farms are also partially included on the periphery of the study area near Terrace. No Crown land is currently under permit for grazing or hay-cutting purposes (Wilson, pers. comm.).

The main constraints to development are the limited size of local markets and distance from large population centres (British Columbia Ministry of Small Business Development 1982). The high cost of land clearing also acts as a deterrent to agricultural development. Costs can exceed $7000/ha or twice land value.

The District Agriculturist is of the opinion that the only area likely to be developed in the near future other than Shames is the Class 2 land near Salvus.

Although capability of river silts for agricultural production is high, access is generally inadequate and expensive land clearing, dyking and/or drainage requirements prohibit development.

(d) Agricultural Land Reserve

Most arable land (Classes 1 to 4) is included in the ALR and these areas are shown (Maps AG-3 to AG-7) along with agricultural capability.

4.2.2 FORESTRY

(a) Methodology

An overview was obtained from two low-level helicopter flights and a number of automobile trips over the accessible portions of the study area in the fall of 1980. An additional 2-day field trip was undertaken in the fall of 1982.

Current forest cover maps were obtained from the Ministry of Forests and the Canadian Cellulose Company Limited (CanCel), now B.C. Timber Limited. Forest inventory data was obtained from the Ministry of Forests. Site classification and topographic maps were also studied.

Each forest type within the route was examined in relation to its site quality, maturity, potential growing stock, species and accessibility. Detailed methodology and forestry data are in Appendix F.

(b) Description of Forest Resource

The study area lies in the Coastal Western Hemlock and Coastal Cedars-Pine-Hemlock biogeoclimatic zones (Section 4.1.4, Vegetation, includes a detailed description of these zones) which have wet coastal climates. The dominant trees of the zone are western hemlock, western red cedar and amabilis fir. Spruce, yellow cedar and cottonwood are dominant species on specific sites.

The majority of the productive forest land in the study area are good to medium sites and are an important component of the forest management units of the region.

The active Skeena River floodplain, marsh areas and rock outcrops create a broad, continuous ribbon of non-productive forest land running the length of the study area.

(c) Forest Management and Industry

(i) Crown Land

Nearly all the productive forest land within the study area is owned by the Crown. A large area south of the Skeena River is managed by B.C. Timber Limited as Tree Farm Licence No. 1 (TFL No. 1). The remainder of the Crown Land is managed by the Forest Service which allocates timber harvesting rights and special uses for the area.

The study area is within the boundaries of two Timber Supply Areas (TSA) of the Prince Rupert Forest Region of the Ministry of Forests. The western portion of the study area is within the North Coast TSA, the remainder of the study area is within the Kalum TSA. Tree Farm Licence (TFL) No. 1 also forms part of the Kalum TSA.

Three significant areas have been designated for harvesting purposes. These Timber Sale Harvesting Licences (TSHL's) are listed in Table 4.2-1.

An area has been assigned to the Municipality of Prince Rupert for recreational purposes (Map LS-1). The timber is managed by the Ministry of Forests.

TABLE 4.2-1

TIMBER SALE HARVESTING LICENCES IN THE SKEENA-RUPERT STUDY AREA

T.S.H.L.	Licence Holder	Location
A-01452	Price Skeena Forest Products Limited	Between Exstew and Remo
A-03624	Q.C. Timber Limited	South of Carnation Island
A-01482	Boyle and Dean Logging Limited	Between Tyee and Prudhomme Lake

(ii) Other Lands

Most of the private lands which contain productive forest are encompassed by or are adjacent to TFL No. 1. Sizeable private lots also exist at Tyee. The Indian reserves in the study area contain less than 1 percent of the productive forest land.

(d) Timber Harvesting

(i) Harvesting Practices

The timber located on flat land or moderate slopes of the Skeena valley is harvested by rubber-tired or cat skidders. The highlead system is used for the steeper hillsides. Some companies are involved in helicopter logging of spruce in areas which are adjacent to salmon spawning grounds or sensitive to road construction. The high value of spruce stands makes helicopter logging economically feasible.

All coniferous species are harvested but some small operators are also logging cottonwood from the islands in the Skeena River and the river flats. The cottonwood logging depends on market conditions and is practiced from January to March during low water conditions. The skidded logs are boomed and towed to the shoreline along the highway for truck loading. They are usually transported to Prince Rupert for marketing.

(ii) Factors Limiting or Restricting Harvesting

Several factors limit the areas in which timber can be grown and harvested:

1. Helicopter harvesting is impractical on steep hillsides above existing transmission lines because of safety and liability problems.

2. The relocation of Highway 16 and the possible double-tracking of the Canadian National Railway (CNR) may make access for salvage harvesting difficult.

3. Annual flooding on the Skeena River restricts harvests to certain times and areas.

4. Areas set aside for protection of fish and wildlife habitat or for recreational use limit the areas available for harvesting.

5. Natural hazards posed by climate and terrain preclude certain areas from being harvested.

6. Market conditions often dictate times and volumes of harvest.

(iii) Accessibility

The major transportation routes between Terrace and Prince Rupert are Highway 16 and the Canadian National Railway located on the north side of the Skeena River. A few logging roads have been developed from the highway into TSHL areas. Access between Terrace and areas near Carnation Island is provided by a few logging roads on the south side of the river. Some of these roads are on the floodplain and are thus restricted by periodic flooding.

(iv) Manufacturing

Most of the timber harvested in the study area is processed by the following local plants:

Prince Rupert Pulpmill (Pt. Edward)	- operated by B.C. Timber
Two Sawmills (at Terrace)	- operated by B.C. Timber and Skeena Forest Products Ltd.
Two Pole Companies (at Terrace)	- owned by Bell Pole Co. Ltd. and Pohle Lumber Co. Ltd.

A small shake and shingle mill (at Terrace).

Logs, including cottonwood, not processed at the local plants are hauled to Prince Rupert for marketing. The hauling distance between Terrace and Prince Rupert is approximately 150 km.

4.2.3 MINING

(a) Introduction

In order to assess the geological resources in the study area literature was reviewed, discussions were held with provincial agency staff, and aerial photographs were examined.

The literature review indicated that the following geological resources should be examined because of their occurrence within the study area or the presence of a favourable geological environment for their occurrence:

1. Base metal deposits.
2. Industrial mineral deposits.
3. Aggregate deposits.

Each showing is illustrated on Maps GM-1 to GM-7 in the accompanying map volume and a brief description is given to assist in evaluating the importance of each showing. Table E-4 in Appendix E is a list of the prospects that are mapped.

(b) Geological Resources

(i) Base Metals

There are three base metal prospects in the study area. These small deposits lie in the Hazelton Group or in Early Tertiary granodiorite that intrudes the Hazelton Group (Map GM-7). Detailed information on the showings is contained in Appendix E.1.

The Iron Cap prospect (70), the Talus Creek prospect (72) and the Autumn prospect (73) lie on the slopes of Mount Remo. The Iron Cap prospect contains magnetite (Fe_3O_4) and chalcopyrite ($CuFeS_4$) mineralization, the Talus Creek prospect contains molybdenite (MoS_2) mineralization and the Autumn prospect contains mainly chalcopyrite mineralization.

(ii) Industrial Minerals

There are two prospects in the area that have been explored and utilized for industrial minerals. One prospect is the Kwinitsa (75) salt deposit and the other is the A.E. Barr (74) limestone quarry. The small salt deposit is in Recent fluvial sediments near the mouth of Kwinitsa Creek; no other deposits of this type are known in the area. Extensive limestone beds occur in Carboniferous, Permian and Triassic strata. These units are exposed along the Skeena River valley, west of Terrace (Maps GM-6 and 7). The A.E. Barr quarry is in Carbonaceous and Permian sedimentary rock. Detailed information on these prospects is contained in Appendix E.2.

(iii) Aggregate Deposits

Numerous rock, sand and gravel deposits are located along Highway 16 and the CNR tracks. These quarries have been used for construction and maintenance of the highway and railway line.

Many of the quarries and pits are old and/or depleted (Table E-4). The quarries are used for rock, borrow, crush base, select base, paving aggregate or surfacing aggregate and the pits are used for gravel or winter sand (Deakin, pers. comm.). Current quarries range from 3000 m³ to almost unlimited reserves, although reserves in many pits are unknown. Some work will be undertaken by the Ministry of Transportation and Highways to re-evaluate the resources at some of the sites, but no schedule has been proposed.

Ministry of Transportation and Highways owns most of the pits and quarries. The CNR uses little rock or aggregate because their track is completed and they require little for maintenance. However, with the new northeast coal agreement the Terrace-Prince Rupert railway line will be upgraded. Considerable rock and crush base may be required. The CNR proposes to build spur lines where necessary and use Ministry of Transportation and Highways' quarries for the material. This would make it unnecessary to close the railway line for blasting and clearing which would be required if the rock was obtained adjacent to the track. The quantities required have not been estimated.

(iv) Mineral Claims

The JZ claims (71) are located near Talus Creek. An airborne magnetometer survey in 1966 and geological mapping determined that the claims are underlain by Late Paleozoic greenstone, shale, argillaceous limestone and limestone, but failed to locate significant mineralization (Parker and Webb 1966). Presumably the persons conducting the survey were looking for iron - copper (magnetite, chalcopyrite) mineralization. There is no information on the Act, Lou, Saga, Bingo, Gisela (5) or Cobalt (28) claims.

Mineral claims generally cover known showings. However, there are current claims south of Kloiya Bay, east of Alder Creek and east of Kwinitsa that are not covering known showings. Current claims, southeast of Mt. Remo, cover the Talus Creek prospect. There are also two groups of cancelled claims southwest of Remo that do not lie on known showings. The reasons for these discrepancies are explained in Appendix E.3.

(v) Mineral Deposit Land Use Planning

Mineral deposit land use planning maps were obtained from the B.C. Ministry of Energy, Mines and Petroleum Resources (We Healdath Environmental and Recreational Consultants Ltd. 1974). These maps assist in ensuring that future development (e.g. parks) do not unnecessarily impact on areas of future mineral utilization. Sand pits, gravel pits and rock quarries were not included on these maps. The numbering system used in designating the importance of areas for mineral potential is explained in Appendix E.4.

Most of the potential transmission corridor has little or no known mineral potential. The only area that is presently of significance for industrial minerals or base and precious metals extends from east of Mt. Remo to west of Shames, where small deposits are possible and where some showings are known.

4.2.4 HERITAGE RESOURCES

(a) Objectives

The objectives of the heritage study were:

1. To rate units of the corridor in terms of their potential for heritage resources.

2. To report known heritage sites.

3. To suggest methodologies for further study.

(b) Methodology

Study activities consisted of:

1. Review of geomorphological, archaeological, historical and ethnological literature.

2. Collection of data from the heritage site file. (British Columbia Heritage Conservation Branch n.d.)

3. Deduction of the type, age and distribution of heritage sites that might be expected.

4. Setting criteria for rating heritage potential in physiographic units.

5. Mapping known sites and areas of potential sites.

(c) Description

A considerable amount of heritage-related fieldwork has been carried out in the lower Skeena valley but most of it is peripheral to this study area.

Early archaeological fieldwork was conducted circa 1910 in the Prince Rupert Harbour area by H.I. Smith of the National Museum of Canada. Smith worked intermittently in the area until the 1920's, concentrating on burial and rock art sites (pictographs and petroglyphs). In 1938 P. Drucker inventoried the harbour area in more detail. C. Borden of UBC excavated a site in the harbour in 1954.

Major fieldwork began in 1966, when the National Museum of Man initiated a series of excavations and surveys in the lower and middle

Skeena River valley. Archaeological excavation occurred at Hazelton, Kitselas Canyon and Prince Rupert until 1975. "Skeena River Prehistory" (Inglis and Macdonald 1979) is the major reference relating to these studies.

Several heritage resource inventory projects sponsored by the Archaeological Sites Advisory Board of B.C. (now Heritage Conservation Branch) have covered part of the study area, but the area between Shames and Khyex has never been carefully examined.

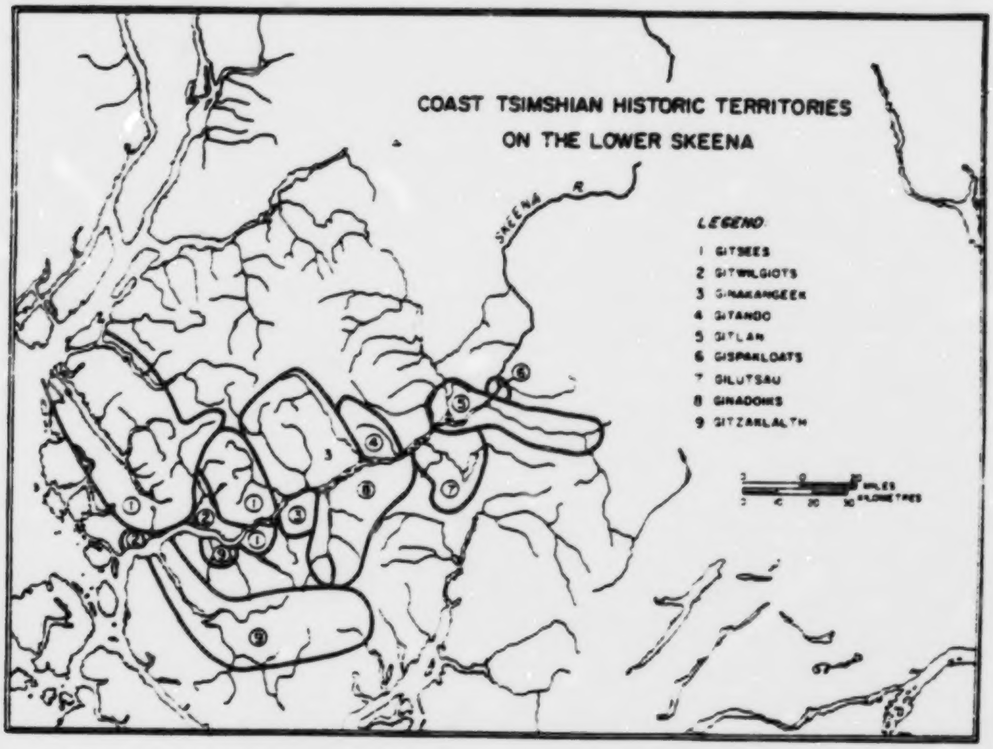
Excavations in the study area have documented a 5000 year history of human occupation. Work in nearby Queen Charlottes and Southeast Alaska suggests that the actual period of occupation may be 8000 to 9000 years (Ames 1979). In proto-historic time (the period immediately preceding colonial settlement) and historic time, the entire area (including the Skeena up to Doreen, 50 km up river from Terrace), was occupied by the Coast Tsimshian Indians. According to their traditions, they originated from a village called Temleham in the vicinity of present-day Hazelton. In contrast, the cultural and archaeological evidence suggests a gradual shift of coastal cultural patterns upriver to Hazelton.

The Tsimshian Indians at the time of historic contact consisted of a number of politically independent "tribes", each with an assortment of territories within which they had exclusive rights to resources. The territories were designated roughly on the basis of drainage areas. In historic times, eight tribes occupied the Skeena River between present-day Terrace and the coast (Fig. 4.2-1).

While both land and water resources were exploited, these cultures had a strong marine orientation. Winter was spent in one of several major permanent villages on the coast in the vicinity of Prince Rupert Harbour. Food consisted of shellfish, fish, sea and land mammals and birds, as well as various plants. The great quantities of shellfish consumed formed the deep coastal shell middens found in the Prince Rupert area. In the spring the villages would disperse to their

FIGURE 4.2 - 1

APPROXIMATE AREA OF COAST TSIMSHIAN TERRITORIES ON THE LOWER SKEENA RIVER*1


COAST TSIMSHIAN HISTORIC TERRITORIES
ON THE LOWER SKEENA
SKEENA R.
LEGEND
1 GITSEES
2 GITWILGIOTS
3 GINAKANGEEK
4 GITANDO
5 GITLAN
6 GISPAKLOATS
7 GILUTSAU
8 GINADOIKS
9 GITZAKLALTH
0 10 20 MILES
0 10 20 30 KILOMETRES
1
2
3
4
5
6
7
8
9

*1 FROM INGLIS AND MacDONALD (1979).

household territories to harvest seasonal resources such as berries, roots, and salmon.

Most sites which might be present along the lower Skeena would have been occupied during spring and summer. These seasonal camps probably consisted of simple plank dwellings, smokehouses and drying racks. Several such camps were seen by a Hudson's Bay explorer in 1832, on the first recorded journey by a white man up the lower Skeena (Inglis and MacDonald 1979).

As well as an area for the harvesting of resources, the Skeena River was of extreme importance as a transportation corridor between the coast and interior. It was largely because of the potential of trade along the Skeena that the Hudson's Bay Company located Port Simpson on the Tsimpsean Peninsula in 1834. This led to a shift of winter villages away from Prince Rupert Harbour and a decline in the importance of the lower Skeena as a resource area. However, control of trade on the Skeena increased in importance. For many years this trade was controlled by a series of chiefs of the name - or title - "Legaic". The large pictograph at Tyee on the Skeena, (Site GbT12), is reported to be associated with this trade monopoly.

By the 1860s the Skeena was becoming a major supply route to the interior for the growing white population. The first sternwheeler reached Little Canyon, near present day Terrace, in 1864. Port Essington at the mouth of the Ecstall River was founded in 1871. Regular sternwheeler traffic operated on the river between 1890 and 1912. It was replaced by the Grand Trunk Pacific Railroad (now CNR) which was completed to the new town of Prince Rupert in 1910.

The few recorded heritage sites on the lower Skeena valley are of three main types: pictographs, burials and general activity sites. Their recorded locations are shown on Maps RC-1 to RC-7. No specific record exists of historic sites in this area.

Three pictograph sites (GbTl1, 5 and 6) are recorded near Tyee but locations of these sites are imprecise and require checking.

One possible burial site (GbTh1) has been reported near Exchamsiks River. This is apparently a rock or cave burial, a known practice on the nearby seacoast. A second burial site is a historic grave marker at Graveyard Point (GdTfH1).

The third type of heritage site, (general activity), includes those sites with a soil deposit resulting from cultural activity and, in some cases, evidence of structures. They are sometimes referred to as fishing stations as this is the most probable activity at the site. Larger ones may have been seasonal or even permanent villages. Known sites are mostly near the mouths of rivers, including Kitsumkalum River (GdTe2), Lakelse River (GcTe1), Zymagotitz River (GcTe2), and Exchamsiks River (GcTh1). Another (GdTe3) is located 2 km west of the Kitsumkalum River.

Away from the Skeena River, but still within the study area, other sites are recorded. A pictograph (GbTm1) is reported near Rainbow Lake. Campsites are found on the shores of Kloiya Bay (GbTn9) and Work Channel near the Lachmach River (GbTl 2 and 4). In the same vicinity is a tidal fish trap (GbTl3) consisting of boulder walls.

Some other heritage sites in the study area are mentioned in a historical account (Large 1957), but their locations are not precisely recorded. The mouth of the Khyex River was the site of Aberdeen Cannery and, perhaps, an Indian village (Tera Environment Resource Analysts 1975). Port Essington at the mouth of the Ecstall River dates from the steamboat era, but was apparently an Indian campsite before that time. Hot Springs Point reportedly had a number of rough buildings associated with the springs. Graveyard Point was a steamship landing and telegraph cabin. Finally, Alastair Lake in the Gitnadoix River valley (south of the study area) was a reported Indian village site.

The sites which are known are concentrated near present watercourses and access routes. The former is probably an indication of the true distribution of heritage sites, while the latter is not. Thus one would expect about as many sites to exist on the south bank of the Skeena River as on the north (where all but one known site are found) and for rivermouths to be especially likely places. Pictographs and rock burials, however, are likely to be found in areas where other types of sites are impossible, such as steep rock outcrops near river (or lake) level. Areas away from the Skeena River, such as the McNeil or Lachmach valleys, are unlikely to contain recent sites, but could contain sites associated with previous higher sea levels.

The geomorphological characteristics of the study area, as discussed in Section 4.1.3, have important implications for heritage resources. It has been suggested that the coast of B.C. may have been a corridor for the migration of Asian peoples into North America. Therefore, the Skeena valley could contain some of the oldest archaeological sites in the province, dating, perhaps, from late glacial or immediate post-glacial times.

Deglaciation on the west coast has been accompanied by both a slight rise in sea level and significant isostatic rebound of the land. Regional isostatic rebound of the coastal area has resulted in up to 200 m of emergence of the former coastline and downcutting of the rivers to present day levels. Ancient sites, should there be any, would be located near former beaches at these higher elevations. Intermediate and newer sites would mostly be located near existing water levels.

Because of erosional processes in the lower Skeena valley, only the newer sites are likely to have been undisturbed and hence relatively easy to locate. For the most part the sides of the valley are extremely steep and no former shorelines or beach deposits have been identified. Valley walls typically hold an actively moving colluvial veneer which, over time, may have buried older marine sediments. In the study area marine sediments are found at the surface only east of the Lakelse River.

Virtually the whole Skeena valley floor is subject to floodplain processes of deposition, erosion and channel shifting. The downstream end of the study area is more active than the upstream end. Air photos indicate a gradual migration in the position of most of the alluvial islands in the lower Skeena valley.

The town of Terrace takes its name from the extensive glaciofluvial terrace development in that area. However, to the west of the Lakelse River there is no visible evidence of river down-cutting or terrace development. The dominant process appears to be sedimentation of the valley, which has emerged from below sea level since the last glaciation.

(d) Known and Potential Heritage Resources

From the foregoing discussion of prehistoric and historic land utilization and study area settlement patterns, criteria were developed to determine areas with high, medium, or low potential for heritage resources. Areas of known heritage resources (based on Provincial Heritage Site Inventory Records) are assumed to be high potential and are indicated on Maps RC-1 to RC-7.

The following criteria were applied to the mapping of other areas to signify the degree of heritage resources potential:

1. High Potential

    a. Large river confluences, shoreline, and associated floodplains and terraces.

    b. Lake shorelines and associated terraces.

2. Medium Potential

   a. Small river and creek shorelines below 61 m (200 ft) in elevation.

   b. Slopes greater than 80 percent with either elevations less than 61 m (200 ft) or proximity to lakeshores, because of the potential for pictographs or rock burial sites.

3. Low Potential

   a. Swamps and bogs.

   b. Slopes of greater than 80 percent and elevations between 61 and 244 m (200 and 800 ft).

   c. Small river and creek shorelines between 61 and 244 m (200 and 800 ft) in elevation.

4. Nil Potential

   a. Unvegetated islands and bars.

   b. Slopes less than 80 percent, greater than 10 percent and elevations less than 61 m (200 ft).

   c. Areas of 10 to 80 percent slope and non-shoreline areas 61 to 244 m (200 to 800 ft) in elevation.

   d. Areas over 244 m (800 ft).

Areas having high and medium potential for heritage resources are being examined in the field during the preliminary stage of heritage assessment. The significance of heritage resources located by those studies cannot be determined at this time. However, once preliminary heritage impact assessment studies are completed, a site significance scheme can be proposed.

4.2.5 RECREATION AND CONSERVATION

(a) Introduction

This section documents the recreation and conservation aspects of the study area. The topics include recreation capability, designated areas for recreation or conservation purposes, access, recreation features and present and potential use. The purpose is to provide an information base upon which impacts associated with the alternative routes for the proposed transmission line can be assessed and compared.

(b) Methodology

Information on the recreation capability of the study area was derived from the Canada Land Inventory (CLI) Land Capability for Recreation Maps (1:50 000 and 1:250 000). In the CLI system, lands and waters are classified according to their capability to sustain recreation use. The assessment of capability is based on aerial photography interpretation, field checks, and data on terrain, views, vegetation, wildlife, etc. There are seven classes. Classes 1 to 3 have very high to moderately high capabilities, Class 4 and Class 5 have moderate and moderately low capabilities; Class 6 and Class 7 are for low and very low capabilities. Within the seven classes, there are 26 (A to Z) subclasses. Subclasses are used to indicate the kinds of features which provide opportunity for recreation, such as "A" for angling or viewing of sport fish or "W" for viewing of wetland wildlife. These are documented in the text and mapped for the study area. In this study, only Class 1 to Class 3 lands are recorded and mapped.

Data were collected from government agency documents, including the Ministry of Lands, Parks and Housing's Parks Data Handbook, the Ministry's park and ecological reserve files, and the Ministry of Forests' recreation project files. Designated areas for recreation or conservation purposes such as parks, UREP (Use, Recreation and Enjoyment for the Public) sites, ecological reserves and designated rest areas are described and mapped based on these data.

The inventory study also makes use of other relevant reports and publications and information from local residents.

Access, outstanding recreation features and recreation activities were noted from a 4 day empirical survey in September 1980. It consisted of a highway survey between Terrace and Prince Rupert, a helicopter reconnaissance over the route, a boat trip along the lower Skeena River and its major tributaries and field checks of parks and rest areas.

(c) Results

(i) Overview

The lower Skeena valley and the Diana-Prudhomme Lake system have rugged, mountainous topography. This, coupled with a climate of heavy rainfall and fog throughout most of the year, limits the recreation potential of the area to specific types of activities and locales.

The recreation users are mostly residents of the nearby communities, Prince Rupert and Terrace. Angling is a popular recreational pursuit of residents. Highway travellers participate in recreation less, although they constitute a major group of scenery viewers in the study area.

There is little potential for recreational hunting, but the Skeena River, its tributaries and other nearby rivers such as the

Lachmach River are important resources for fishing and boating. The visual landscape is also a significant recreation resource to the area, and the need for proper management is emphasized by the Ministry of Forests (British Columbia Ministry of Forests 1979).

Special plant communities exist in the study area. Some of these communities have obtained or are being considered for ecological reserve status. Only non-consumptive recreation which does not alter the natural process of the ecosystems is allowed in ecological reserves.

(ii) CLI Capability

In the CLI system, the study area is divided into the uplands, which generally have moderately low to low recreation capability (Class 5 to 6), and the valley bottom and shorelands which have mostly moderate recreation capability (Class 4).

The upland areas are characterized by varied topography affording limited and dispersed hiking, nature study or aesthetic appreciation opportunities (Subclasses F, R, V).

Table 4.2-3 lists the high to moderately high capability areas. The kinds of features which provide opportunity for recreation in each area are indicated. This information is also documented on Maps RC-1 to RC-7.

The CLI system reflects intrinsic capability of the land and does not necessarily confirm actual use for recreation, or take into account modifications to the land by either human activities or natural processes. Among the areas listed in Table 4.2-3, both the Scotia River mouth and the Dasque Creek mouth have been subjected to enormous changes. The former is a logging camp serving the logging and booming activities in the vicinity. The latter has had serious natural erosion. Neither area would be able to sustain recreation use of the kinds suggested by the CLI

TABLE 4.2-2

DESIGNATED RECREATION AREAS

Parks	Location	Campsites	Tables	Toilets	Day-Use Shelters	Parking Spaces	Remarks
1. Diana Lake*[1] Class A Provincial Park	14 km E of Prince Rupert	-	50	8	3	180	- 400 m of developed beach - 2 km of hiking trail
2. Prudhomme Lake*[2] Class A Provincial Park	16 km E of Prince Rupert	18	-	4	1	-	- native program - lake boating (boat launch nearby)
3. Exchamsiks River*[2] Class A Provincial Park	56 km W of Terrace	10	9	2	1	20	- scenic Exchamsiks Rock - boat launch nearby
Ministry of Forests UREP Sites							
4. Devil's Island*[1]	64 km W of Terrace	-	3	1	-	10	- spectacular view - popular fishing spot
5. Exstew River*[3]	37 km W of Terrace	-	2	2	-	10	- boat launch nearby - popular fishing spot
6. Lakelse River*[3]	E bank of Lakelse River near mouth	-	3	2	-	4	- popular fishing spot

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Source:

*[1] British Columbia Ministry of Lands, Parks and Housing (n.d.).

*[2] British Columbia Ministry of Lands, Parks and Housing (1980).

*[3] British Columbia Ministry of Forests (1980b).

TABLE 4.2-3

CLI CLASS 2 AND CLASS 3 RECREATION AREAS IN THE LOWER SKEENA VALLEY AND THE DIANA-PRUDHOMME LAKE SYSTEM*[1]

Location	CLI Class	CLI Subclasses*[2]	Subclass Description*[3]
McNeil River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Khyex River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Ayton Creek Mouth	3	KAY	Shoreland Camping, Angling, Boating
Scotia River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Khtada River 1 km from Mouth	2	FVR	Waterfall, Viewing, Rock Formation
Shoreland North of Selma Island	3	KAY	Shoreland Camping, Angling, Boating
Alder Creek Mouth	3	KAY	Shoreland Camping, Angling, Boating
Kasiks River Mouth	3	AKY	Angling, Shoreland Camping, Boating
Exchamsiks River Mouth	2	AKY	Angling, Shoreland Camping, Boating
Shoreland North and South of Hudson Bay Flats - 7 km West of Exstew River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Dasque Creek Mouth	3	KAY	Shoreland Camping, Angling, Boating
Shames River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Shoreland 4 km east of Amsbury	3	KAY	Shoreland Camping, Angling, Boating
Lakelse River Mouth	3	KAY	Shoreland Camping, Angling, Boating
Zymagotiz River Mouth	3	KAY	Shoreland Camping, Angling, Boating

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*[1] Environment Canada (1972b, 1978).

*[2] Subclasses are listed in order of importance. Subclass letters refer respectively to subclass descriptions.

*[3] Capability does not necessarily reflect existing use.

system. In addition the mouth of McNeil River is currently being considered by the village of Port Edward for an industrial site and logging is planned in the valley upward to Skip Mountain. These activities would lower the natural recreation capability of this area (Clarke, pers. comm.).

(iii) Designated Areas for Recreation and Conservation

Most designated recreation areas are located near Highway 16. There are three Class A provincial parks in the study area: Diana-Rainbow Lake (233 ha), Prudhomme Lake (7 ha) and Exchamsiks River (18 ha). The Ministry of Forests maintains three UREP sites: Devil's Island, Exstew River and Lakelse River. Table 4.2-2 lists the facilities available in the parks and UREP sites. Their locations are shown on Maps RC-1 to RC-7. There are also three recreation reserves which are being considered for UREP status: the Khyex River, Salvus Slough and Exstew Slough (British Columbia Ministry of Lands, Parks and Housing 1980). The Ministry of Transportation and Highways maintains a number of rest areas along the highway. Although these rest areas are mainly pull-off sites for highway motorists, many of them afford views of the Skeena River.

The only ecological reserve in the study area is located opposite the mouth of the Exchamsiks River in the Skeena River. The reserve (No. 63) is known as the Flood Plain Islands Reserve, with a total area of 132 ha. The reserve was established to preserve the plant communities on the islands. They consist of red alder, aspen, sitka spruce and red cedar, which are regarded as prime examples of their kind (British Columbia Ministry of Lands, Parks and Housing 1978).

Five other areas were covered by ecological reserve applications. Two applications are still active. The ones withdrawn are the Shames River mouth, the Kwinitsa Creek drainage system and the area northwest of Tyee. They are either already logged or regarded as future timber harvesting areas (British Columbia Ministry of Lands, Parks and Housing 1978).

The two active applications are the Gitnadoix valley and the area east of Rainbow Lake. The Gitnadoix valley is a popular retreat for local recreationists. The watershed which comprises the proposed ecological reserve is approximately 58 000 ha. The drainage contains relatively unique ecosystems and highly scenic landscapes, suited for nature study and appreciation. The area is being considered for park status instead of ecological reserve status, as the latter is deemed too restrictive and difficult to manage. However, a smaller ecological reserve may still be possible (British Columbia Ministry of Lands, Parks and Housing 1980).

The proposed ecological reserve east of Rainbow Lake is approximately 190 ha. It is being considered because of the abundance and exceptional associations of plant species typical of the vegetation types in the area (British Columbia Ministry of Lands, Parks and Housing 1978).

(iv) Important Recreation Features

The most important recreation feature in the study area is the Skeena River itself (Table 4.2-4). The upstream portion between Terrace and Kwinitsa is narrow and marked by numerous alluvial islands and tidal sand bars. The downstream portion is much wider, has fewer islands and is rarely braided. The upstream portion is suitable for river boating, canoeing, angling and aesthetic appreciation of varied island vegetation and shoreline features (Plates 4.2-1 and 4.2-2). The downstream portion is only suitable for viewing from vantage points along the highway. Ayton Island, one of the few downstream river islands, is an important waterfowl habitat, affording wildlife observation opportunities.

PLATE 4.2-1

Hudson Bay Flats - Island Vegetation

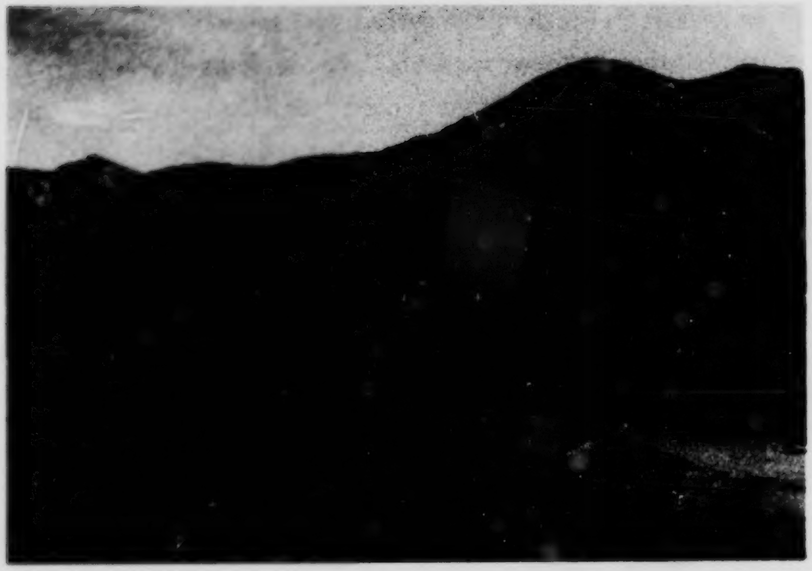

PLATE 4.2-2

Tidal Sand Bar at Mouth of Kwinitsa River (Looking South from Highway)

The confluences of the tributaries with the Skeena mainstem are important for recreation (Table 4.2-4). The Exchamsiks, Gitnadoix, Khyex, Kasiks and Khtada confluences are outstanding. The Exchamisks River mouth is a CL1 Class 2 recreation area. A Class A provincial park was established on the east bank of the river across from the scenic Exchamsiks rock cliff. The area affords high quality fishing and shoreline activities such as family camping. Riverboats can be launched from the west bank of the river. Mountain goats, moose and waterfowl can be observed.

The Gitnadoix River is considered a wild river by the Ministry of Forests although there is no official designation. No development has taken place. The river is noted for its magnificent scenery such as waterfalls, snow- capped mountain tops, river rapids, varied landscapes and diverse plant communities. The river has been promoted for Wild River Park status by the British Columbia Wildlife Federation and Ecological Reserve status by the Ecological Reserves Committee. Although no decision has been made, several government agencies and recreation groups feel that the river system should be preserved, as consumptive recreation pursuits are seen as endangering the wilderness quality of the river system. Both fishing and hunting are popular, especially at the mouth of the river. Boating is popular, although not pursued extensively.

The mouth of the Kasiks River affords good fishing opportunity. Devil's Island, one of the delta islands, is a UREP site which was set aside for day-uses such as picnicking. Opportunity for photography and panoramic views of the Skeena River is excellent. The boat launch at the site is well used. The delta is also an important habitat for both moose and waterfowl, valuable to wildlife observers and hunters.

The Khyex River mouth offers recreation opportunities similar to the Kasiks. However, boating is less frequent because tidal action constantly shifts the launching site gravel.

TABLE 4.2-4

IMPORTANT RECREATION FEATURES

Features	Approximate Location	Possible Recreation Use
Rivers		
1. Main channel of Skeena River - Tyee to Kwinitsa	km 21S-55	Panoramic viewing of main river and adjacent mountains.
2. Main channel of Skeena River - Kwinitsa to Zymagotitz River	km 55-124	Boating, canoeing up to Lakelse, aesthetic appreciation of vegetation and alluvial islands, fishing - coho, steelhead.
Confluences		
3. Khyex River mouth: tidal gravel beds, vantage points, wildlife habitat	km 27S-36S	Viewing, wildlife observation.
4. Khtada River mouth: wildlife habitat, scenery	km 49-51	Viewing, wildlife observation.
5. Kasiks River mouth: delta island with vantage points, day-use facilities, scenic river channels, wildlife and fish habitat	km 67N-77S	Viewing, wildlife observation, day-use boating, fishing - coho, cutthroat, dolly varden
6. Exchamsiks River mouth: scenic Exchamsiks rock cliff, scenic river channel, wildlife and fish habitat, park facilities	km 77N-79N	Viewing, boating, general park use, wildlife observation, hiking, camping, picnicking, fishing - coho
7. Gitnadoix River mouth: spectacular scenery, fish and wildlife habitat	km 81-86	Nature observation, fishing - coho, chinook
Lakes		
8. Taylor-Prudhomme Lakes: small lakes, gentle shorelands, provincial park facilities	km 5-9S	Lake boating, family camping, picnicking and general park use.
9. Diana Lake: gentle expansive shorelands, provincial park facilities	km 5-7	Camping, picnicking, hiking and general park use.
10. Rainbow Lake: scenic shoreline features	km 11S-14S	Lake boating, hiking, viewing.

The Khtada River has picturesque waterfalls and rock formations. Situated on the south bank of the Skeena, the river is not as accessible as the Kasiks and Khyex. The river mouth is habitat for waterfowl.

Frizzel Hot Springs, near Hotspring Point is rated "superb" in the book "Hotsprings of Western Canada".

The Prudhomme-Diana-Rainbow Lake system offers different recreation opportunities (Table 4.2-4). The lakeshore is suited for family types of recreation including camping, picnicking, and short hiking trips. The lakes provide boating opportunities. The area is scenic, although there are no spectacular features. This area is particularly important to the Prince Rupert residents, as there are few areas with these types of recreation opportunities. Two Class A provincial parks, Diana Lake and Prudhomme Lake, primarily serve the local residents. As the populations of Prince Rupert and Port Edward grow, meeting demand for more parks will become increasingly difficult.

Other recreation features are scattered throughout the Skeena valley and the Prudhomme-Diana Lake systems. Their locations are shown on Maps RC-1 to RC-7. Detailed descriptions of angling and wildlife areas are provided in Appendix G.

(v) Access

Throughout the area, access for recreation is limited by the rugged topography and is mainly confined to valley bottoms. The most important road access is the Yellowhead Highway (Hwy. 16) along the north side of the Skeena Valley. The Skeena River is visible and easily accessible along most of the highway. The highway provides many vantage points for travellers.

There are few side roads off the highway. They are usually less than 10 km along a tributary of the Skeena River. Most were built for logging purposes. Use of these roads for recreation is low. Access roads along the Exstew River and the Khyex River are used by recreationists (British Columbia Ministry of Forests 1980c).

The 12 km road built for the logging operation in the Lachmach River Valley provides access from the highway to Work Channel where boating, fishing, camping and related activities are popular recreational pursuits. As logging expands, the road may be built into the Prudhomme River valley.

Road access on the south side of the Skeena River is restricted to a few logging areas. The Lakelse River is accessible at several points by logging roads. The roads provide access to fishing spots, boat launches, and to a minor extent, hunting areas. The west bank of Scotia River is another logging area served by an access road. The road is not used for recreation purposes.

In addition to the road system, the Skeena River provides access to the area, although its use is limited due to the boating distances involved. Because of strong currents, power boats are the preferred mode. Canoeing mainly takes place on the Skeena River east of Kwinitsa Creek. West of Kwinitsa Creek the river is too strong and swift for canoeing. The river and the tributaries are unsuitable for whitewater kayaking.

Another means of access to the area is float planes. They service areas such as Alastair Lake and the upper reaches of some tributaries which are not accessible by river or road.

(vi) Present and Potential Use

The common recreation activities in the area are angling, riverboating, camping, day-hiking and weekend picnicking. The scenic qualities of the area support passive activities such as viewing of mountains, glaciers, waterfalls, wildlife and landscapes, nature study and photography. Less pursued activities include long-distance hiking, canoeing, hunting and winter snowshoeing.

In 1979, the total traffic volume on the highway was an estimated 230 300 vehicles (British Columbia Ministry of Transportation and Highways 1980a). Local and commercial traffic constituted 45 percent of this total. The remainder, 126 700 vehicles, consists of tourists travelling through the area. Traffic volume growth in the near future is forecast at between 3.5 and 6.2 percent per annum (Marshall, Macklin, Monaghan Ltd. 1979).

The total party-days spent in the area for recreation in 1979 were approximately 34 500. (A party-day is defined as a day, or reasonable part of a day, spent in the area by a party of people travelling in a single vehicle. A party is defined as four persons.) The figure (34 500) is based on the 1972 estimate for the area (27 117) (Hoos 1976) and an annual growth rate of 3.5 percent. Of the total 34 500 party-days, 29 300 or 85 percent were used by local residents (British Columbia Ministry of Forests 1980a). Thus, few motorists travelling through the area via the Yellowhead Highway actually stop in the area for recreation except for camping and scenery viewing.

Both Exchamsiks River and Prudhomme Lake provincial parks are well used as day-use recreation sites all year and overnight campgrounds in the summer. In 1979, Exchamsiks River Park was used for a total of 927 party-nights and 2328 party-days. Park use records were kept only for May to September at both parks. Prudhomme Lake Park was used for a total of 1718 party-nights.

Slightly over 60 percent of the night-users were not British Columbia residents (British Columbia Ministry of Lands, Parks and Housing 1980). This indicates that the parks are important stop-overs for tourists. Diana Lake Park is newly established, and no park use statistics are yet available.

Statistics on the use of the UREP sites were only kept for the Lakelse site and Exstew river sites. In 1980, it was estimated that 3000 and 1800 people visited the sites respectively (British Columbia Ministry of Forests 1980b).

Sportfishing for chinook, coho and steelhead in the Skeena mainstem is an important form of recreation pursued mainly by residents. In 1973, residents accounted for 87 percent of the angling effort in the area (Hoos 1976). The season starts in July, peaks in August and declines during September. Angling catch for chinook in the Skeena system in 1980 was estimated at 3000 fish (Canada Department of Fisheries and Oceans 1981). Estimates of coho catch are not available. Steelhead catches in the Skeena mainstem averaged 1208 fish during the 5-year period 1973 to 1978 (B.C. Fish and Wildlife Branch 1973-1978). Catches of cutthroat and Dolly Varden occur in the Skeena River as well, however, no statistics are available for these species. In 1973, the economic benefit derived from sport fishery in the area amounted to $412,400 (Hoos 1976).

Hunting in the area is light and dispersed, limited by lack of access, and almost exclusively pursued by residents from the adjacent communities. The study area falls mainly within Game Management Units 6-10, 6-14 and 6-15. Table 4.2-5 summarizes the hunting effort and harvest in the study area. Moose is the most sought after game, followed in decreasing order by deer, black bear, mountain goat and grizzly bear. The 1976 to 1979 statistics indicate that hunting pressure on moose and deer is increasing while pressure on mountain goat, black bear and grizzly bear is decreasing. The regional wildlife management

TABLE 4.2-5

HUNTING EFFORT AND HARVEST IN THE LOWER SKEENA VALLEY, AND THE PRUDHOMME-LACHMACH VALLEY SYSTEM, 1976 TO 1979*[1]

	Harvest			Hunter Days			Harvest/Hunter Days		
Species	1976/77	1977/78	1978/79	1976/77	1977/78	1978/79	1976/77	1977/78	1978/79
Moose	19	19	49	260	665	1110	.07	.03	.04
Deer	0	0	0	49	29	340	-	-	-
Black Bear	36	21	12	312	310	198	.16	.68	.06
Grizzly Bear	6	1	2	75	68	29	.08	.01	.07
Mountain Goat	6	3	4	34	35	33	.18	.09	.12

Note: The figures shown in this table are derived statistics from Management Units 6-10 and 6-15, based on estimates. Data on Management Unit 6-14 indicate that no hunting effort or harvest were reported from our study area.

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*[1] British Columbia Fish and Wildlife Branch (1976-1979).

policy is that increases in hunting for moose and deer in the area be discouraged and that habitats for all species be carefully observed and monitored (British Columbia Fish and Wildlife Branch 1980f).

4.2.6 VISUAL RESOURCES

(a) Introduction

It is evident to the many travellers and residents familiar with Highway 16 between Terrace and Prince Rupert that the study area (and the Skeena River valley in particular) is an attractive landscape. Many portions of the area are also popular recreational boating, angling and camping areas which are used to a large extent because of their natural scenic values.

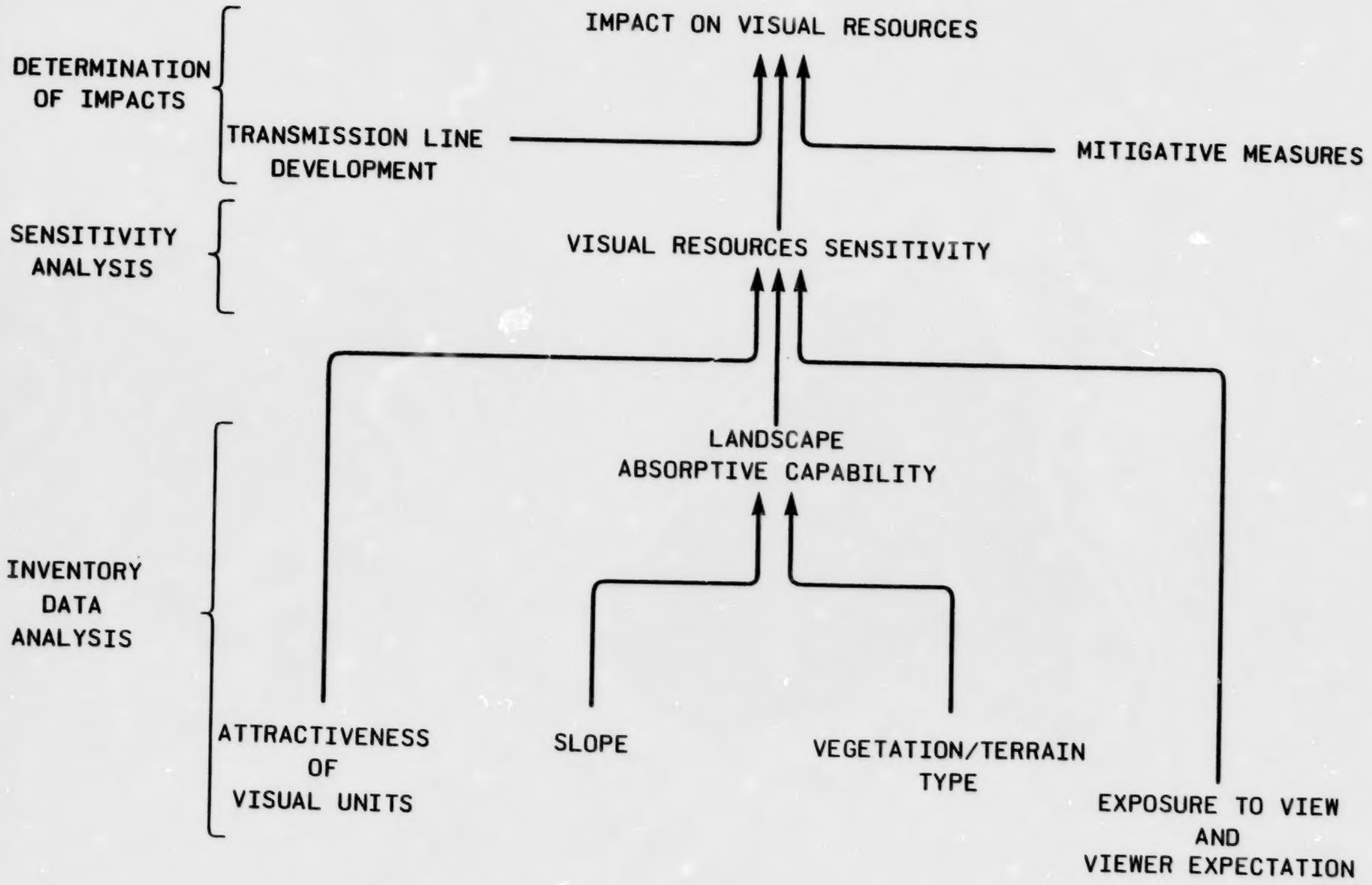
The major thrust of the visual resources inventory was to evaluate those aspects of terrain, vegetation and water resources which are perceived by people as having aesthetic value. These aspects are also ones which determine the tolerance of various landscapes to development or disturbance.

(b) Methodology

The method of visual analysis employed in this report is based on one formulated for the Northeast Coal Block studies (Tetlow and Sheppard 1977). It utilizes the concept of visual units to determine attractiveness or scenic distinction. Landscape absorptive capability (also termed visual vulnerability), and exposure to view (also termed visibility) are two other concepts from earlier studies (Beak Consultants Limited 1979). These factors (Fig. 4.2-2) help to define the tangible aspects of the visual resources which determine their value.

FIGURE 4.2-2

METHODOLOGY FOR VISUAL ANALYSIS


IMPACT ON VISUAL RESOURCES
DETERMINATION OF IMPACTS
TRANSMISSION LINE DEVELOPMENT
MITIGATIVE MEASURES
SENSITIVITY ANALYSIS
VISUAL RESOURCES SENSITIVITY
LANDSCAPE ABSORPTIVE CAPABILITY
INVENTORY DATA ANALYSIS
ATTRACTIVENESS OF VISUAL UNITS
SLOPE
VEGETATION/TERRAIN TYPE
EXPOSURE TO VIEW AND VIEWER EXPECTATION

To determine attractiveness, the study area was divided into visual units. Such units are portions of the landscape enclosed by topographic features which bound an observer's field of view and assist him to form a unified impression of his surroundings (Tetlow and Sheppard 1977). Within each unit a number of factors related to landscape contrast, diversity of water form and landform, etc. contribute to attractiveness. Visual units were delineated on topographic maps with the help of air photographs and verified in the field in September 1980. At the same time each unit was rated on a series of 20 scenic distinction factors which were the basis for attractiveness ratings for each unit.

Exposure to view was determined both in the field and from topographic maps. Viewpoints considered were roads and residential or recreation areas. Viewer expectation was also a factor: an already disturbed landscape would not be altered as significantly by new development as would an undisturbed landscape.

Landscape absorptive capability is "the natural potential of landscapes to absorb visual alternation arising from development" (Tetlow and Sheppard 1977). It is a product of both the slope and the vegetation/terrain characteristics of an area. Slopes were determined from topographic maps. Vegetation and terrain characteristics were gleaned from aerial photographs.

(c) Analysis of Visual Factors

(i) Attractiveness of Visual Units

Visual units were rated on a series of 20 scenic distinction factors (Table 4.2-6) to determine the features which have important visual values and to determine if some units were more attractive than others. Attractiveness is shown in Maps VR-1 to VR-7 by the fourth letter of the code for each landscape area. The following discussion summarizes the results.

TABLE 4.2-6

SCENIC DISTINCTION SCORES*[1]

Scenic Factor*[2]	Visual Unit Morse	Prudhomme	Rainbow	Green River	Lachmach	Skeena Estuary	Skeena Channels	Lakelse
Spatial Vividness	7	24	8	8	24	24	30	2
Cross-Section Complexity	16	24	4	7	18	24	24	4
Cross-Section Proportion Index	12	12	6	30	30	30	30	30
Cross-Section Contrast	10	16	4	10	21	10	30	6
Linearity and Continuity	6	10	3	5	21	12	18	1
Skyline	10	12	5	7	24	18	12	5
Profile	9	18	8	13	16	16	24	5
Floor	12	16	12	12	16	24	30	5
Lakes: Extent and Character	30	24	12	10	2	0	2	10
Rivers: Extent and Character	0	3	3	8	5	12	12	6
Lakes: Shoreline Form	8	18	24	10	1	0	0	6
River: Shoreline Form	4	6	4	6	5	5	8	3
Water Setting	8	10	8	8	4	16	16	4
Setting Frequency	16	8	10	18	8	5	16	9
Falls and Rapids	2	3	2	3	3	0	4	4
Peaks	10	12	10	10	12	12	12	6
Snow and Ice	0	0	0	3	3	3	8	0
Vegetation Contrasts	2	5	4	8	10	7	24	6
Visual Unit Linkages	10	10	5	9	9	12	24	0
Impacts and Degrading Contrasts	3	7	6	8	4	7	7	0
Total Score	175	238	138	193	236	244	331	112
Adjusted Score*[1]	58	79	46	64	79	81	110	37
Attractiveness Rating*[3]	Mod.	Mod.	Mod.	Mod.	Mod.	High	High	Low
Map Designation	M	M	M	M	M	A	A	L

---

*[1] Scoring was done independently by three people, so the scores are cumulative. Scoring by each person was on a scale of 0 to 10 as described in Tetlow and Sheppard (1977). The adjusted scores are the total scores divided by three.

*[2] Explanations of these terms may be found in the reference noted above.

*[3] Ratings were given in accordance with Tetlow and Sheppard's (1977) scoring levels:

Low	0 to 39
Moderate	40 to 79
High	80 to 119
Very high	120 to 159
Outstanding	160 to 200

The Skeena Channels and Skeena Estuary visual units were given high ratings (Table 4.2-6) because of the vividness and complexity of their landscapes. The narrow steep-sided nature of the Skeena valley focuses attention on the river as a dominant feature. The ruggedness of the enclosing mountainsides and peaks adds to the distinctiveness. The valley is wider and less enclosed at the estuary which accounts for a lower overall score for the estuary unit.

Five units were given moderate attractiveness ratings overall. The Prudhomme and Lachmach units have the same total scores but for different reasons. The major focal point of the Prudhomme Lake area is the lake itself. The valley is fairly well enclosed and the vegetation and terrain provide diversity and contrast. The Lachmach unit has a small river along the valley floor and several small lakes but its distinctive characteristic is the narrowness of the valley contrasted with the steep high enclosing mountainsides. The outstanding features of the Green River unit are the contrast between its narrow valley and high mountain peaks and the diversity of water forms - lakes, rivers and creeks in various terrain types. The major feature in the Morse unit is Morse Basin, of which Kloiya Bay is a part. The unified nature of the basin and its enclosing mountains also contribute to its attractiveness. Rainbow Lake is the focal point of the Rainbow unit. Its intricate shoreline figures largely in the attractiveness of the unit.

The only visual unit rated low is the Lakelse unit. Although individual features such as the lake itself and nearby mountains are attractive, the valley's sprawling and highly developed nature were factors which weighted against it in the ratings.

(ii) Exposure to View

This factor is a product of the degree of visibility of a landscape and the expectations of the majority of viewers. As summarized in Table 4.2-7, landscapes rated high were relatively undeveloped areas visible from roads or other areas. Moderate ratings were given to landscapes which were partially visible, viewed from a long distance or those which may be altered by logging or other development. Low exposure areas are those areas rarely seen from any viewpoint. Exposure ratings are indicated by the third letter of the codes given to landscapes in Maps VS-1 to VS-7.

(iii) Landscape Absorptive Capability

The ability of a landscape to absorb development without undue visual alteration is determined by the slope of the landscape and the way the terrain and vegetation mesh together. On Maps VR-1 to VR-7, slope is indicated by the first letter in the code and terrain/vegetation type by the second letter. The product of these factors gives an absorptive capability rating of high, moderate, or low (Table 4.2-8).

Low capability areas are generally found on steep to intermediate slopes with uniform forest cover and either no conspicuous terrain pattern or vertically patterned terrain in combination with steep slopes. Large areas of the Skeena valley mountainsides fall into this category because of steepness and vertical terrain patterns due to gullying and avalanching.

Moderate capability areas have variable slopes and tree cover. The typical tree cover on gentle to intermediate slopes is continuous but sometimes irregular due to clumping of various ages or species of trees. On steep slopes with discontinuous tree cover, capability is also considered moderate. Distribution of such areas is widespread throughout the study area.

TABLE 4.2-7

EXPOSURE TO VIEW

Exposure Rating[*1]	Criteria
High (R)	- Areas readily seen from viewpoints such as roads, railroads, recreation or residential areas.
	- Expectations of viewers do not include development or disturbed landscapes.
Moderate (D)	- Large areas seen from a long distance or small areas seen from a short distance.
	- Expectations of viewers may include other than natural landscapes.
Low (O)	- Areas seen occasionally from viewpoints.
Nil (-)	- Areas never seen from viewpoints.

[*1] Letters in parantheses refer to map designations (Maps VR-1 to VR-7).

TABLE 4.2-8

LANDSCAPE ABSORPTIVE CAPABILITY

	Slope		
	Steep (S)	Intermediate (I)	Gentle (G)
Terrain/Vegetation Description	>30%	15 to 30%	<15%
Continuous uniform tree cover - either all deciduous, all coniferous or even mixture of both. No conspicuous terrain patterns. Open water. (U)	Low	Low	Moderate
Continuous but irregular tree cover (uneven ages or clumped species distribution). or Discontinuous tree cover with vertical terrain pattern (gullied slopes). (V)	Low	Moderate	Moderate
Discontinuous tree cover, terrain pattern horizontal or irregular. (Burn area, newly logged areas, bogs.) (T)	Moderate	High	High

Note: Letters in parantheses refer to map designations (Maps VR-1 to VR-7).

Landscapes with high absorptive capability are always gentle to intermediate-sloped areas with discontinuous forest cover. Such areas are often sparsely treed bogs, islands with seral shrub vegetation or newly logged sites. Because cut-over areas in most cases will regenerate over a period of time, only active logging areas and sites with little obvious regeneration were given moderate to high absorptive capability ratings. Existing corridors for roads, transmission lines and pipelines were also considered to have high absorptive capability. Older logged areas were considered to have continuous but irregular tree cover and given low to moderate ratings.

4.2.7 COMMERCIAL AND SUBSISTENCE WILDLIFE USE

(a) Methodology

Information on commercial and subsistence use of wildlife was obtained from trapper and guide returns supplied to the Fish and Wildlife Branch, from published information, and from interviews with government personnel (Appendix K).

(b) Trapping Activity

Portions of 22 traplines are located in the study area (Fig. 4.2-3). Of these lines, nine have been active in recent years. One active trapline is held by native Indians, who are not required to report their returns. There may be some minor trapping by native Indians on reserve lands. Table 4.2-9 summarizes trapper activity and the approximate value of furs harvested on the eight non-native lines which were active at some time from 1975 through 1979.

These data represent returns from entire traplines, not just the sections potentially affected by the transmission line. The portion of each trapline which may actually be crossed by the transmission

TABLE 4.2-9

TRAPPING ACTIVITY AND FUR VALUES IN STUDY AREA, 1975 TO 1979

	1975/76			1976/77			1977/78			1978/79		
	Harvest*[1]	Average Price*[2] ($)	Value ($)	Harvest*[1]	Average Price*[2] ($)	Value ($)	Harvest*[1]	Average Price*[2] ($)	Value ($)	Harvest*[1]	Average Price*[2] ($)	Value ($)
Marten	102	19.18	1956.36	81	22.24	1801.44	98	21.19	2976.62	63	33.82	2130.66
Mink	23	16.20	372.60	16	15.55	248.80	13	15.69	203.97	4	27.85	111.40
Fisher	1	75.51	75.51									
Otter	10	65.27	652.70	2	68.92	137.84	7	59.90	419.30	3	100.10	300.30
Weasel	1	0.96	0.96	27	0.78	21.06	24	1.53	36.72	10	2.29	22.90
Wolverine	1	177.75	177.75	5	199.82	991.10	2	180.11	360.22	4	200.06	800.24
Fox	31	66.57	2063.67	3	61.80	185.40	20	70.39	1407.80	5	92.80	464.00
Coyote				1	46.55	46.55						
Wolf	2	116.45	232.90	1	105.41	105.41						
Beaver	76	19.45	1478.20	63	22.95	1445.85	54	18.48	996.30	32	36.24	1159.68
Muskrat				20	4.25	85.00				8	5.89	47.12
Squirrel				5	0.75	3.75	7	1.57	10.99	5	2.56	12.80
TOTAL	247		7010.65	224		5072.20	225		5511.92	134		5049.10
Active traplines			5			4			6			5
Mean value/trapline		1402.13				1268.05			918.65			1009.82

---

*[1] Data from British Columbia Fish and Wildlife Branch files, Terrace and Prince Rupert.

*[2] Data from British Columbia Fish and Wildlife Branch 1979a, 1979e, 1979f, 1979h, 1980c, 1980e and B. Saunders, Fish and Wildlife Branch, Victoria.

line is relatively small. However, many of the affected areas are especially important to trappers because they are riparian sites, the preferred habitat of several furbearer species.

The average number of pelts taken annually on these traplines was 207, and their average total value was $5661. The average income for each trapline was $1150. This average is misleading, as some trappers were considerably more active than others. For some trappers in some years, trapping may have contributed substantially to total income, but for most trapping is an avocational pursuit (D. Crack, pers. comm.).

Although trapping is obviously of minor commercial importance in the study area, its importance as a way of life to those who practice it must be considered.

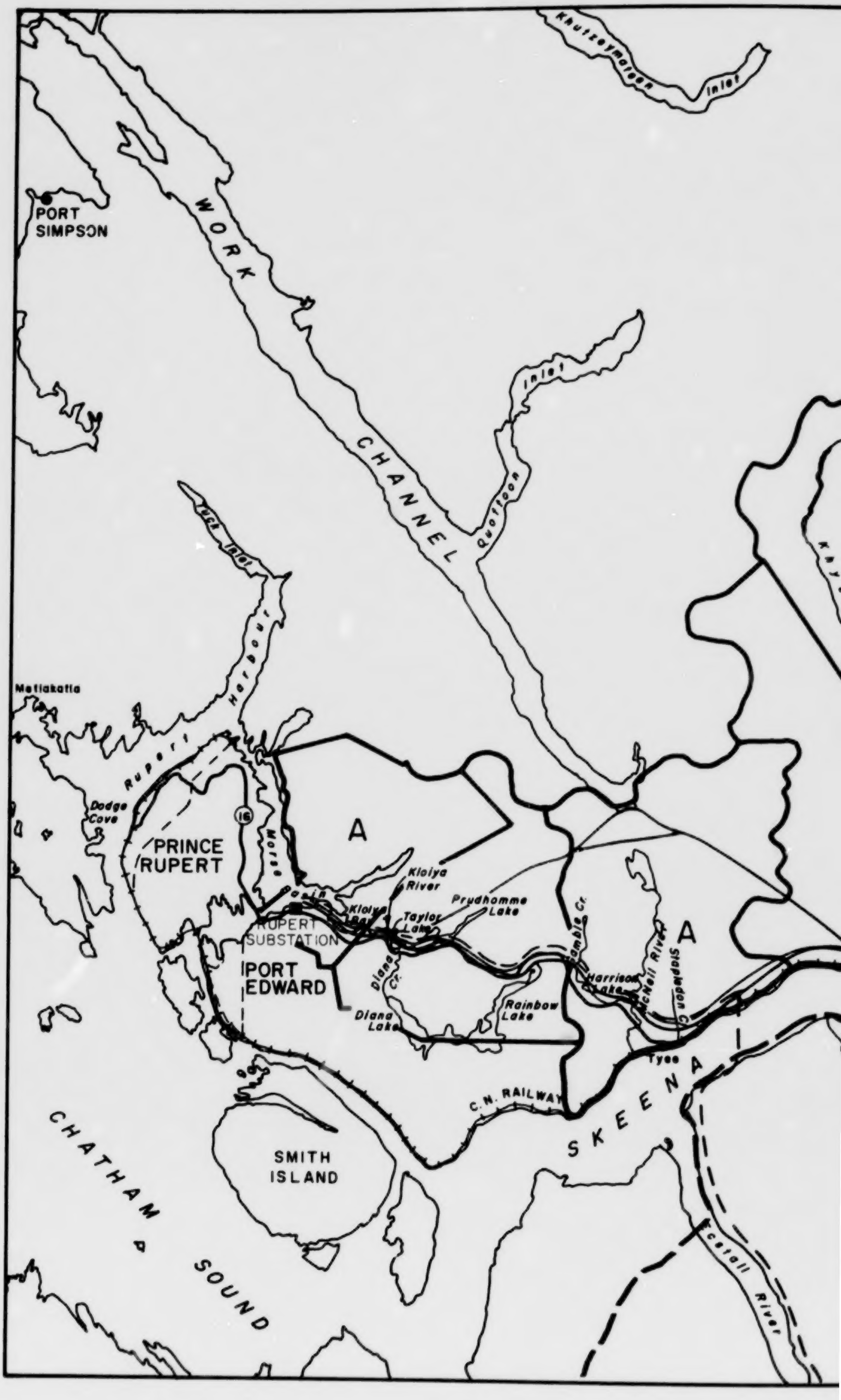
(c) Guiding Activity

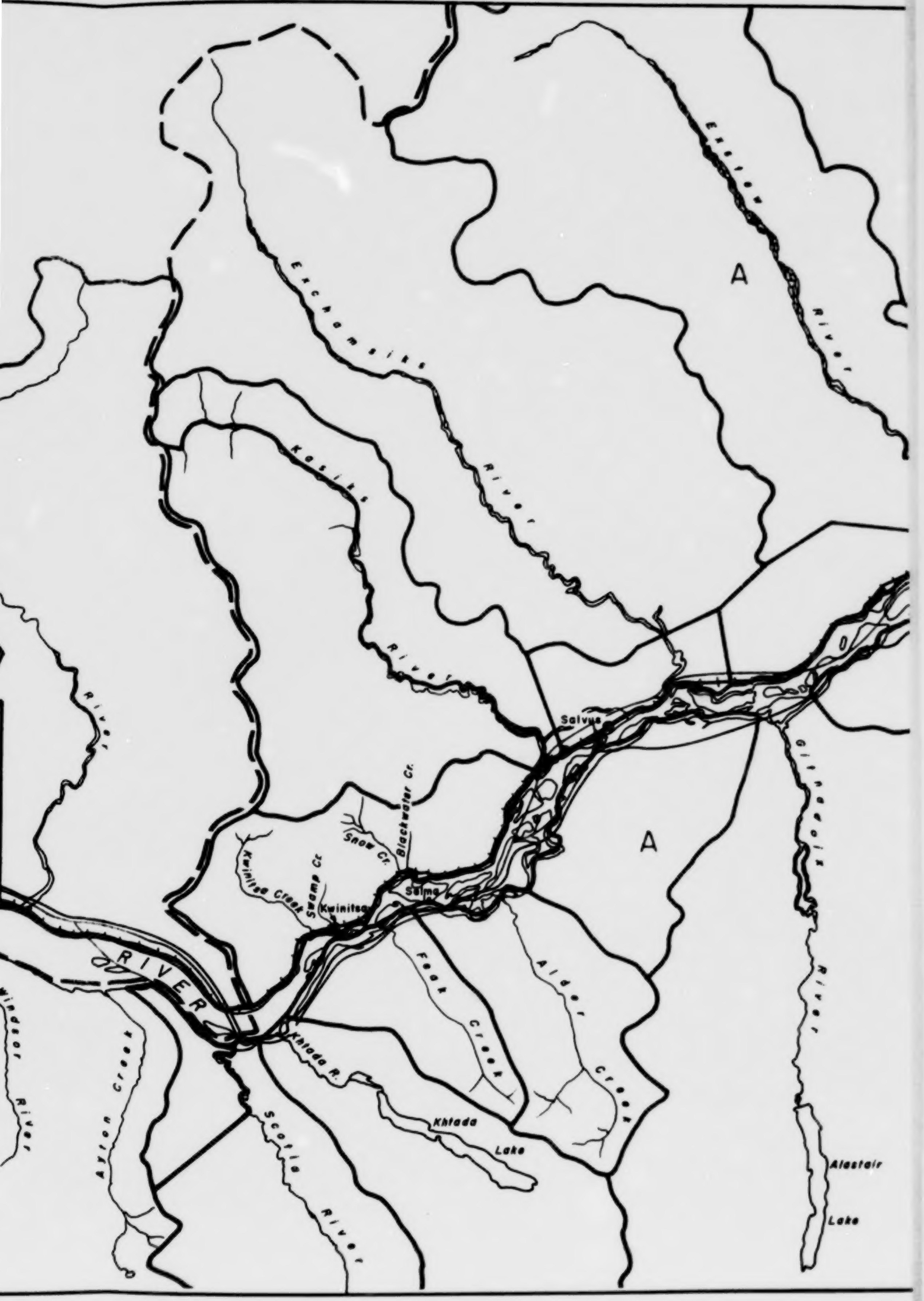
Most of the study area falls within one guide outfitter territory (Fig. 4.2-3). This territory, which has been inactive for several years, was in use during 1980. Guide returns for this territory are summarized in Table 4.2-10. Data for the 1968 to 1970 seasons represent an area with slightly different boundaries.

The economic importance of guiding is more difficult to quantify than that of trapping. Guides charge for their services at a daily rate, which averaged $172 in 1978 (Canadian Resourcecon Ltd. 1979). They may receive additional payments if a hunt is successful. The regional economy benefits from expenditures on transportation, food and accommodation. The provincial government receives licence fees.

(d) Subsistence Hunting

Subsistence hunting in the study area is thought to be minimal. As native Indians are not required to purchase licenses to hunt in season, no information is available on in-season subsistence hunting.


Khutzeymateen Inlet
PORT SIMPSON
WORK CHANNEL
Quottoon Inlet
Tuck Inlet
Metlakatla
Rupert Harbour
Dodge Cove
PRINCE RUPERT
16
Morse Basin
A
Kloiya River
Kloiya Bay
Prudhomme Lake
Taylor Lake
RUPERT SUBSTATION
PORT EDWARD
Diana Cr.
Diana Lake
Rainbow Lake
Gamble Cr.
Harrison Lake
McNeil River
Stapledon Cr.
A
Tyee
C.N. RAILWAY
SKEENA
SMITH ISLAND
CHATHAM SOUND
Ecstall River


Exstew River
A
Exchamsiks River
Kasiks River
River
Salvus
Blackwater Cr.
Snow Cr.
Swamp Cr.
Kwinitsa Creek
Kwinitsa
Salma
A
Gitnadoix River
RIVER
indsor River
Ayton Creek
Feak Creek
Alder Creek
Khtada R.
Khtada Lake
Scotia River
Alastair Lake

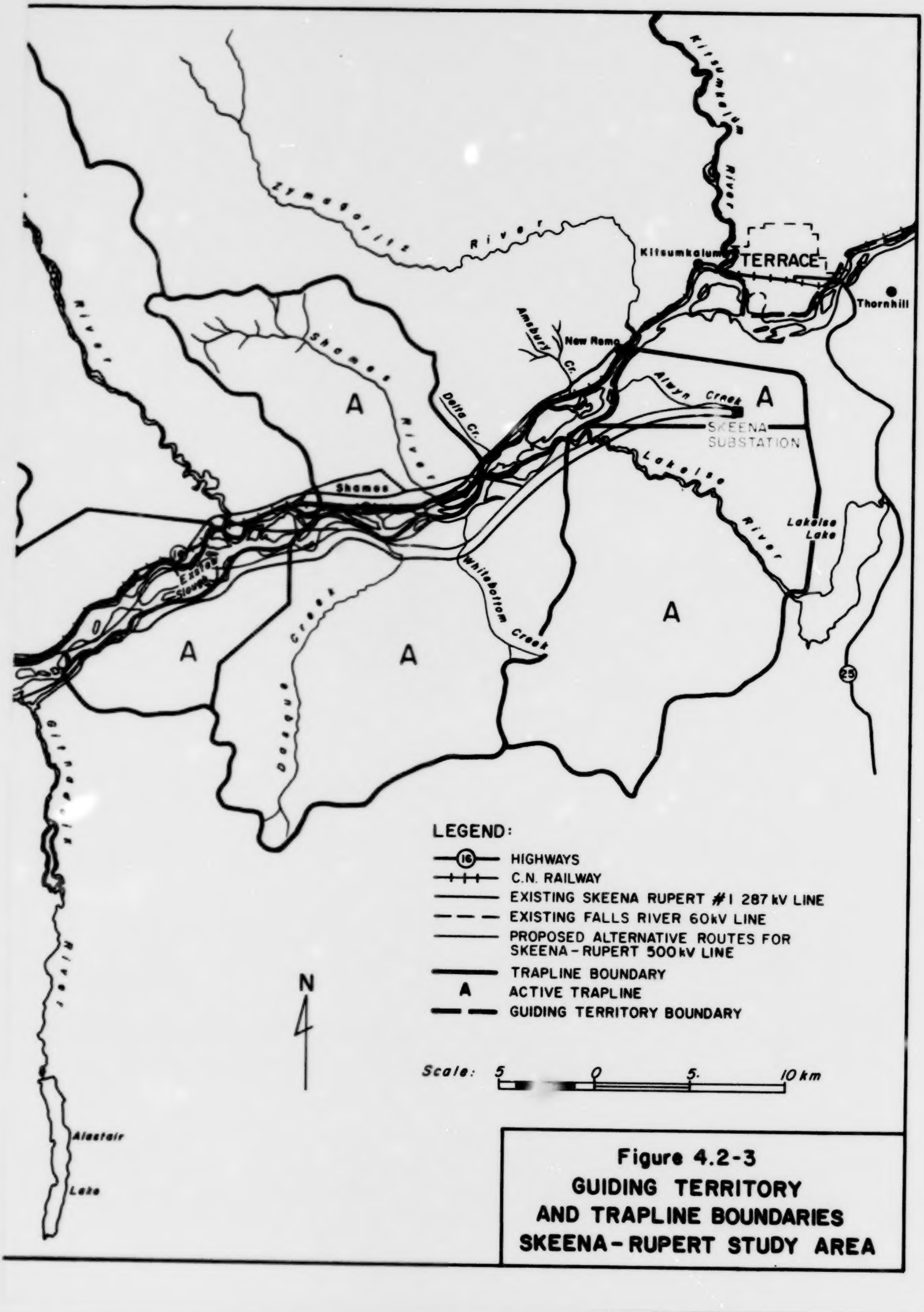

Kitsumkalum River
TERRACE
Kitsumkalum
Thornhill
Zymagotitz River
Amsbury Cr.
New Remo
Alwyn Creek
SKEENA SUBSTATION
Shames River
Delta Cr.
Lakelse River
Lakelse Lake
Shames
Exstew Slough
Whitebottom Creek
Dasque Creek
River
Gitnadoix River
Alastair Lake
16
25
A
A
A
A
A
LEGEND:
16 HIGHWAYS
C.N. RAILWAY
EXISTING SKEENA RUPERT #1 287 kV LINE
EXISTING FALLS RIVER 60kV LINE
PROPOSED ALTERNATIVE ROUTES FOR SKEENA-RUPERT 500kV LINE
TRAPLINE BOUNDARY
A ACTIVE TRAPLINE
GUIDING TERRITORY BOUNDARY
N
Scale: 5 0 5 10 km

Figure 4.2-3
GUIDING TERRITORY
AND TRAPLINE BOUNDARIES
SKEENA-RUPERT STUDY AREA

TABLE 4.2-10

GUIDE RETURNS FOR THE TERRACE AREA, 1968 TO 1970 AND 1980*[1]

	1968	1969	1970	1980
Black bear	3	3	2	3
Grizzly bear	1	2	1	
Mountain goat	1	3		1
Wolf	2			1
Moose	1			3

---

*[1] Data from British Columbia Fish and Wildlife Branch files, Terrace.

Native Indians may hunt on reserve lands at any time, but as most of the reserves within the study area are small and relatively inaccessible, they are probably not used much for this purpose. For other out-of-season subsistence hunting, a permit is required. No subsistence hunting permits have been issued for the study area in recent years (D. Crack, R. Escott, pers. comm.). One aspect of the Indian study will be to clarify the degree of subsistence resource use.

4.2.8 COMMERCIAL AND FOOD FISHERIES

(a) Commercial Fisheries

A commercial seine, gill-net and troll fishery in Fisheries Statistical Area 4 exploits salmon stocks destined for the Skeena River. Study area salmon stocks, predominantly pink and chum salmon, are taken by this fishery (R. Kadowaki, pers. comm.). Statistical Area 4 is roughly bounded in the north, south and west by Dundas and Porcher islands, and in the east by a boundary at Tyee on the Skeena River just upstream of McNeil River. The peak fishing months are June, July and August. Over the last decade, recorded landings of salmon and steelhead trout in this fishery have averaged 1.7 million fish (Table 4.2-11). Tagging has shown that the chinook and coho catches include a significant portion of fish destined for rivers other than the Skeena (R. Kadowaki, pers. comm.). Landings of steelhead trout, which are taken incidentally in the salmon fishery, have been consistently underestimated by at least 50 percent owing to non-reporting of the catch (Oguss and Evans 1978) .

(b) Native Food Fisheries

In the study area there are two separate food fisheries pursued by native Indians under special permit: 1) a drift gill-net fishery in tidewater (Area 4) under day permit; and 2) a set gill-net fishery,

TABLE 4.2-11

COMMERCIAL NET AND TROLL FISHERY LANDINGS OF SALMON AND STEELHEAD TROUT IN THE SKEENA RIVER ESTUARY, STATISTICAL AREA 4, DURING 1970 TO 1979*[1]

	Number of Fish Caught by Species (x1000)						
	Chinook	Sockeye	Coho	Pink	Chum	Steelhead	Total
Mean	32.1	840.3	79.2	639.5	56.3	4.9	1652.4
Range	14.0- 52.2	406.0- 1382.0	45.0- 148.9	207.0- 1392.0	14.0- 119.9	3.0- 8.4	940.0- 2422.0

---

*[1] Canada Department of Fisheries and Oceans, Pacific Region. British Columbia Catch Statistics, 1971 to 1980, Vancouver.

principally by the Kitsumkalum Indian Band, in the Skeena River near the mouths of the Shames, Exchamsiks and Kasiks rivers, under a combination of season and day permits. In 1980 the tidewater fishery in Area 4 landed an estimated 37 000 salmon (81 percent sockeye) with 528 boat-days of fishing effort (S. Kriegl, pers. comm.). The upriver fishery in 1980 caught approximately 9500 salmon and steelhead trout between the Kalum River and tidewater (J. Hipp, pers. comm.). The approximate species breakdown of the catch was as follows: sockeye (80 percent); pink (5 percent); chum (3 percent); chinook (4 percent); coho (3 percent) and steelhead (5 percent). There were 20 seasonal permits and 150-day licences issued for this upriver fishery in 1980.

Eulachon are also harvested for food purposes during their spawning run in March and April (J. Hipp, pers. comm.). Gillnets and dipnets are used to capture eulachon in the Skeena mainstem between Kasiks and Scotia rivers. As the harvest is relatively small, data on the catch and fishing effort have not been collected by the Department of Fisheries and Oceans.

SUB-SECTION 4.3 - SOCIO-ECONOMIC RESOURCES

4.3.1 LAND STATUS AND USE

(a) Introduction

The Skeena-Rupert study area is sparsely settled and is largely comprised of vacant Crown land. The predominant land use is as a transportation and utilities corridor. Highway 16, the Canadian National Railway, and B.C. Hydro's 287 kV transmission line are the most evident land uses in the study area. The valley also contains a natural gas pipeline. The major settled areas are near Terrace and Prince Rupert, and there is some settlement at Shames.

For the purpose of this study land status includes: provincial Crown land under lease, easement or reserve; water rights; Crown-granted (private) land; and federal Crown Indian reserves. Other forms of tenure or status such as parks, forest leases and mineral reserves are included under separate sections which have these resource uses as their focus. Potential settlement areas are also identified. The analysis is based on available data from government agencies and was verified by air photo analysis. No field studies were undertaken.

(b) Methodology

(i) Provincial Crown Leases, Easements and Reserves

The data source for provincial Crown land tenures is the Ministry of Lands, Parks, and Housing. The regional office in Smithers maintains information on current leases, easements and reserves. The Ministry also maintains province-wide "Ministerial reference maps" which identify land tenures.

(ii) Water Rights

Water rights include several categories of use. This section examines all sources of community and individual water rights, as well as mineral springs and Order-in-Council water reserves. The principal source of information is the Water Rights Branch, Victoria. Data were collected from the Stream Register, maps and government files. Appendix H lists data sources and detailed information.

(iii) Crown-Granted Lands

Crown-granted or private land was identified using B.C. Assessment Authority assessment roll for 1981 and B.C. Hydro Properties Division information. Features identified in the roll that were of use to this study were: actual use; type and age of building structures; form of tenure and property size. Appendix H lists the properties examined.

(iv) Potential Land-Use

Potential land use sites were identified in discussions with the planners of the Kitimat-Stikine and Skeena-Queen Charlotte regional districts, the regional planner for Lands, Parks and Housing and the village clerk from Port Edward.

(v) Federal Crown Land

Indian reserve data are provided by the federal Department of Indian and Northern Affairs (Table 4.3-1). Appendix H lists data sources and detailed information on leases, easements and reserves.

TABLE 4.3-1

INDIAN RESERVES IN STUDY AREA*1

Reserve Number	Name	Band	ha
IR8	Khyex	Metlakatla/Port Simpson	-
IR10	Khtahda	Metlakatla/Port Simpson	2.8
IR11	Scuttsap	Port Simpson	-
IR11A	Scuttsap	Metlakatla/Port Simpson	12.1
IR70	Alder Creek	Port Simpson	5.0
IR71	Kasika	Port Simpson	3.8
IR72	Kasika	Port Simpson	4.1
IR26	Salvus	Port Simpson	1.3
IR73	Dzagayap	Port Simpson	7.1
IR74	Dzagayap	Port Simpson	3.8
IR75	Gitandoiks	Port Simpson	3.8
IR76	Gitandoiks	Port Simpson	4.1
IR85	Ksames	Port Simpson	8.0
IR86	Klakelse	Metlakatla/Port Simpson	14.0
IR1	Kitsumkaylum	Kitsumkalum	455.3
IR3	Zymagord	Kitsumkalum	29.9
IR16	Lachmach	Port Simpson	10.8
IR61	Wudzimagon	Port Simpson	2.2
IR65	Imkusiyan	Port Simpson	4.9

Note:

1. Former Kilkutsal IR1 and 1A (Lakelse and Skeena River Confluence) and Kloiya IR5 (near Prince Rupert) were acquired by Celgar Ltd.*2

2. Former Port Simpson reserves 66 and 9 (at Scotia River and Skeena River confluence) were sold to Columbia Cellulose in 1952.*2

*1 British Columbia Hydro and Power Authority (1979).

*2 Robinson (pers. comm.).

(c) Discussion

(i) Crown Leases, Easements and Reserves

There are six Crown leases in the study area, one of which is an industrial lease for B.C. Hydro's Rupert Substation.

There are three B.C. Hydro electrical easements and a pipeline easement for the Pacific Northern Gas Company natural gas pipeline in the study area.

There are 32 provincial reserves and 19 Indian reserves in the study area.

(ii) Water Rights

A. Community Water Supply

There is one community watershed south of the study area near the Rupert Substation. The Wolf Creek system is a 14.5 km^2 watershed which serves the village of Port Edward. Provincial guidelines allow no encroachment into reservoirs of this size (Map LS-1).

B. Individual Water Licences

There are 13 water licences and two applications for licences in the study area. Of the 13 licences six are held by B.C. Timber, formerly Canadian Cellulose Company Ltd. (CanCel), for regulation of water for industrial purposes. CN Rail has a licence for industrial use from Stapledon Creek.

C. Mineral Springs and Order-in-Council Water Reserves

There are two mineral (hot) springs on the south side of the Skeena River near km 26S. There is a blanket reserve protecting all mineral springs in B.C. from use or development unless approved by the Ministry of Lands, Parks and Housing.

The Kloiya, Ecstall and Skeena rivers are affected by Order-in-Council reserves which state they are reserved for the use of the Crown.

(iii) Crown-Granted Lands

There are a total of 97 privately owned properties in the study area. Sixty of this number, or two-thirds of all the privately held land, are within 10 km of Terrace. The remainder are scattered along the valley to Prince Rupert. Property sizes vary between 0.14 and 253 ha. Most of the large properties are owned by forest companies and have no improvements on them. Smaller properties, i.e. under 4 ha, tend to be close to Terrace and are rural-residential.

(iv) Potential Land Use

In general, none of the interviewees foresee any major development within the study area in the immediate future. The focus of attention by Skeena-Queen Charlotte Regional District is on existing communities. They encourage development in the existing centres and forsee no substantial growth in the Skeena valley. Kitimat-Stikine Regional District has no immediate development plans within the study area.

The Ministry of Lands, Parks and Housing recognize the potential for agricultural and rural residential use as far west as the Exstew River. There is a "low priority" planning proposal to release Crown land in the area. However, flooding and other issues have led to the proposal being deferred at present.

The village of Port Edward was granted a boundary extension by the Province in 1980. As a result, the boundaries now extend north to Kloiya Bay and east to Tyee. There are a number of proposed projects in the Port Edward area. Tyee is considered to be one of the best suited sites in the lower Skeena-Prince Rupert area for industrial development. For this reason the Port Edward Official Community Plan specifies that any industrial use requires a development permit. Tyee is one of the sites on which Dome Petroleum is considering locating a gas conversion plant.

4.3.2 HUMAN ENVIRONMENT

(a) Study Area

The Human Environment study area extends slightly beyond the areas mapped for other resources. It includes portions of the Kitimat-Stikine and Skeena-Queen Charlotte Regional districts (within an area commonly known as the Skeena valley) including the municipality of Terrace on the east, and the municipality of Prince Rupert and the village of Port Edward on the west (Fig. 4.3-1).

(b) Demography

Table 4.3-2 summarizes the population distribution in the study region between 1961 and 1981.

The study area has a relatively youthful population, typical of resource-based northern communities. A very small percentage of the region's population is of retirement age.

The population of the Prince Rupert area has grown steadily since the completion of the Grand Trunk Pacific Railway in 1914 which stimulated

FIGURE 4.3 - I
SKEENA-RUPERT HUMAN ENVIRONMENT STUDY AREA AND REGIONAL DISTRICTS IN NORTHWESTERN BRITISH COLUMBIA

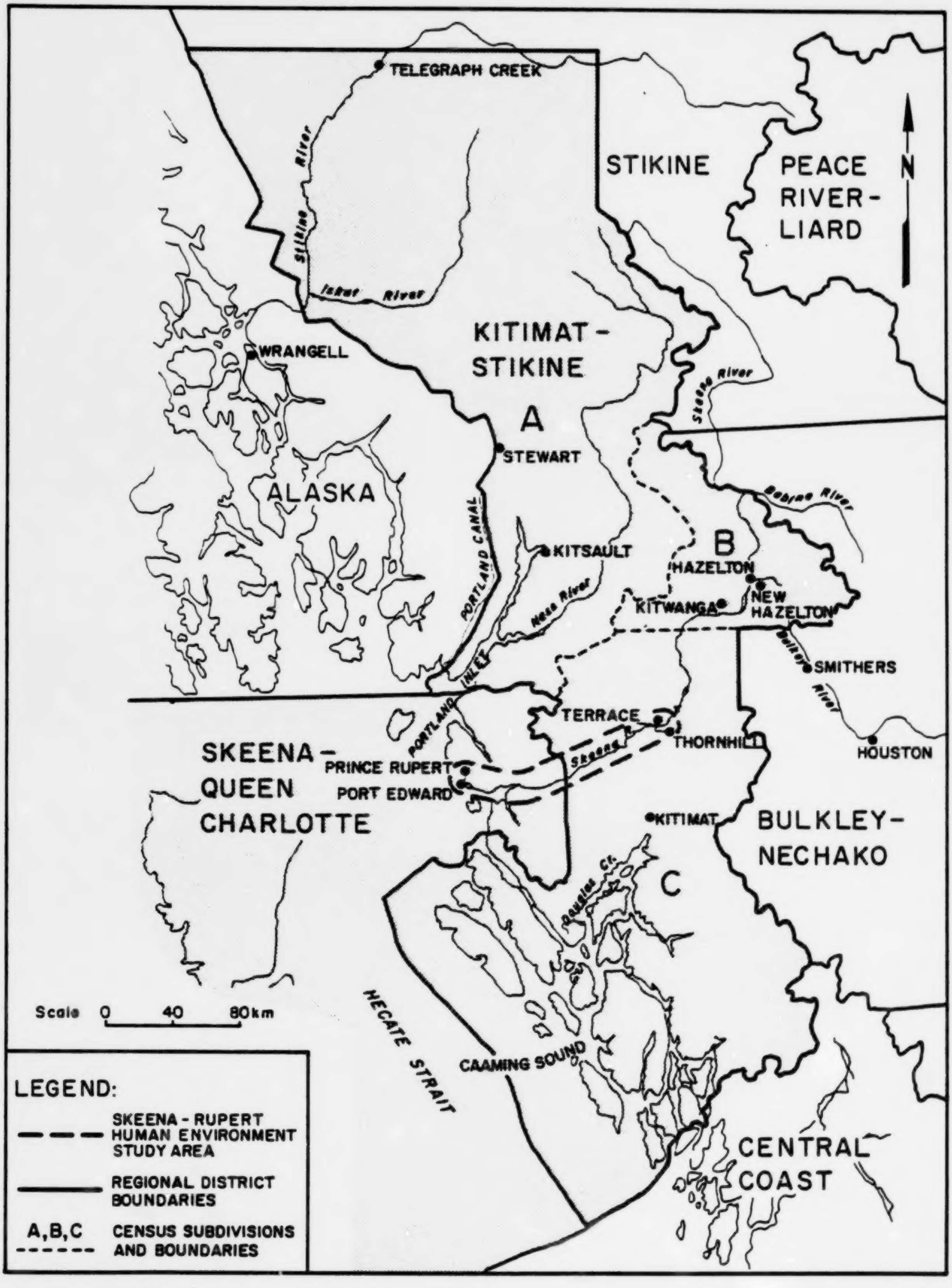

TELEGRAPH CREEK
Stikine River
Iskut River
STIKINE
PEACE RIVER-LIARD
N
KITIMAT-STIKINE
A
WRANGELL
Skeena River
STEWART
ALASKA
Babine River
PORTLAND CANAL
KITSAULT
B
HAZELTON
NEW HAZELTON
KITWANGA
Nass River
PORTLAND INLET
SMITHERS
Bulkley River
TERRACE
THORNHILL
HOUSTON
SKEENA-QUEEN CHARLOTTE
PRINCE RUPERT
PORT EDWARD
Skeena
KITIMAT
BULKLEY-NECHAKO
Douglas Ch.
C
Scale 0 40 80km
HECATE STRAIT
CAAMING SOUND
CENTRAL COAST
LEGEND:
SKEENA-RUPERT HUMAN ENVIRONMENT STUDY AREA
REGIONAL DISTRICT BOUNDARIES
A,B,C CENSUS SUBDIVISIONS AND BOUNDARIES

TABLE 4.3-2

POPULATION AND ITS DISTRIBUTION IN THE NORTHWEST REGION 1961 TO 1981*1

	1961	1966	1971	1976	1981
Kitimat-Stikine Regional District	23 031	29 745	37 326	38 718	42 400
Terrace	5 940	8 637	9 991	10 251	10 914
Skeena-Queen Charlotte Regional District	14 556	17 560	17 947	17 153	18 402
Prince Rupert	11 987	14 677	15 747	14 754	16 197
Port Edward	---	---	1 019	1 207A*2	989
Northwest Total	38 811	48 920	56 743	57 416	62 755

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*1 Statistics Canada, 1941, 1971, 1976. 1941, 1971, and 1976 Census, Skeena-Queen Charlotte Division and Kitimat-Stikine Division. Computer printout.

*2 An "A" indicates a boundary change between 1976 and 1981.

the establishment of the city. Historically, the area was the most heavily populated portion of the northwest region. However, in recent years, industrial and resource developments in other parts of the region, together with improved transportation links to the interior, have gradually diminished Prince Rupert's relative importance as a regional population and economic centre. Nevertheless, the city of Prince Rupert is still the region's largest incorporated centre, with a 1981 population of 16 197. Another 989 live in the neighbouring village of Port Edward.

Terrace has a 1981 population of 10 914 with an estimated additional 5000 living in unincorporated communities in the Terrace fringe area.

Settlement within the proposed corridors is sparse. A family of four settled at Shames several years ago to develop farmland to supply vegetables to local markets. A family of three reside at Kwinitsa. At Salvus there is a Highways yard with a crew size that varies between twelve in the winter and four during the summer (Webber, pers. comm.). There is also a highway maintenance camp near Selma Island and a logging camp at the mouth of the Scotia River.

Traditionally, the area has been home to the Metlakatla, Port Simpson and Kitsumkalum Indian bands. Band populations as of May 1982 (Hanley, pers. comm.) are as follows:

	On Reserve	Off Reserve	Total
Metlakatla	102	165	267
Port Simpson	950	556	1506
Kitsumkalum	60	67	127

The bands have 19 reserves within the human environment study area ranging from 1.3 to 455.3 ha (Table 4.3-1). Some are owned jointly. Only the Kitsumkaylum IR 1 is presently occupied. Reserve locations are indicated on Maps LS-1 to LS-7.

(c) Economic Base

The economy of the Prince Rupert - Terrace area has traditionally been dominated by the resource and export-oriented industries, among which forestry and fisheries are the major sectors. As regional economic centres, both Prince Rupert and Terrace also share an important role in transportation, government and tertiary services, although each centre has slightly different emphasis.

The major industries of the Prince Rupert - Port Edward area are fishing, fish processing, forest products, transportation, and to a lesser degree, tourism. Major employers include B.C. Packers, B.C. Timber, the CNR, and port facilities such as the Prince Rupert grain terminal. The largest employment sectors are manufacturing, community and personal services and transportation.

The economy of the Terrace area is primarily based on the forest industry, represented by logging, sawmilling and pole construction. The major employer is B.C. Timber. Apart from forestry, the Terrace economy is dominated by the trade, services and administration sectors which are becoming increasingly important to its economy. This level of tertiary activity reflects Terrace's position as a regional service centre and as a trans-shipment point for railway and highway freight (British Columbia Ministry of Industry and Small Business Development 1982).

Although there are indications of some decline in the fishing industry, and the forest industry has limited growth potential, it is predicted that prospects for economic growth in the region are relatively good in the 1980s (British Columbia Ministry of Industry and Small Business Development 1982). Growth can be expected in areas such as terminal developments, (e.g. the Dome Liquified Natural Gas Plant), transportation, and tourism.

(d) Employment and Income

Table 4.3-3 compares the change in population, labour force and participation rates from 1976 to 1981 between the regional municipalities, the Skeena area and the province.

Table 4.3-4 lists the experienced labour force by industry for 1971 for Prince Rupert and Terrace. Six percent of the total is in the construction sector. Table 4.3-5 lists the number of UIC claimants in the area in 1979, demonstrating that construction unemployment is seasonal and that the rate of unemployment in this occupation is relatively high in comparison to other occupations.

The unemployment rate in the area has traditionally been high which is typical of northern resource-based communities. In January 1982, the rate was 11.7 percent for the northwest region as a whole in comparison to the provincial rate of 9.8 percent (British Columbia Ministry of Industry and Small Business Development 1982). This reflects the high labour turnover because a large proportion of the labour force is engaged in cyclical or seasonal jobs in the fishery, forestry and service sectors. Over the past year, the region has experienced a serious increase in unemployment particularly in fishing and forestry. Prince Rupert reported a 20 percent unemployment rate in June 1982 (Dome Petroleum Ltd. 1982) and Terrace reported a 60 percent increase in unemployed registrants between November 1981 and November 1982 (Kneen, pers. comm.).

In comparison to many other northern communities and the province as a whole, the average income in the study area was relatively high in 1979 (Table 4.3-6). However, this higher income is often offset by a higher cost of living in northern communities. The current recession will have an impact on income distribution, but the nature of this change is unknown.

TABLE 4.3-3

CANADIAN EMPLOYMENT CENTRE (CEC) POPULATIONS AND LABOUR FORCE
1976 TO 1981
(000's)

	Population			Working Age Population			Labour Force			Participation Rate %		
CEC/Area	1976	1981	Chg%	1976	1981	Chg%	1976	1981	Chg%	1976	1981	Chg%
Prince Rupert*[1]	17.1	18.0	5.0	12.0	13.2	9.6	7.9	9.3	18.1	65.8	71.0	5.2
Terrace	20.0	19.7	-1.1	13.2	13.4	1.7	8.7	9.8	11.6	65.6	72.0	6.4
AREA TOTAL	75.6	80.0	5.7	50.8	55.8	9.8	33.3	39.6	18.8	65.6	70.9	5.3
B.C. TOTAL	2466.6	2710.3	9.9	1871.2	2120.7	13.3	1118.6	1353.0	21.0	59.8	63.8	4.0

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*1 Includes Port Edward.

TABLE 4.3-4

PERCENTAGE DISTRIBUTION OF EXPERIENCED LABOUR FORCE BY INDUSTRY IN THE LOWER SKEENA AREA*1, 2

Industry	Prince Rupert-Port Edward Area (%)	Terrace Area (%)
Manufacturing	29	13
Community and Personal Services	20	24
Transportation, Utilities	14	10
Trade and Commerce	9	19
Public Administration	9	4
Construction	5	7
Fishing and Trapping	4	0
Forestry, Logging	3	14
Mineral Extraction	0	0
Agriculture	0	1
Unspecified	7	8

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*1 Statistics Canada (1971).

*2 Current data (1981) will not be available until 1983.

TABLE 4.3-5

NUMBER OF UIC CLAIMANTS IN THE LOWER SKEENA AREA, 1979*[1]

Occupation	Prince Rupert and Port Edward				Terrace Area			
	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.
Managerial	6	5	4	6	10	8	5	7
Sciences	5	7	5	5	14	11	6	4
Social Sciences	2	3	6	4	4	3	5	8
Teaching	9	11	18	10	13	10	8	9
Medicine	18	9	13	6	28	30	23	9
Artistic	3	4	1	1	2	3	3	4
Recreation	0	0	1	0	3	0	0	0
Clerical	103	95	84	56	110	100	86	87
Sales	38	43	23	31	61	68	50	36
Service	120	122	91	58	140	121	102	77
Farming	2	2	2	3	5	6	1	2
Fishing, Trapping	40	31	15	24	3	2	1	1
Forestry, Logging	22	13	6	6	165	60	31	27
Mining	7	8	1	1	14	11	4	0
Processing	650	615	435	274	59	59	50	44
Machining	10	9	8	3	24	19	15	7
Fabricating	17	19	16	15	38	29	16	23
Construction	152	137	72	49	332	252	138	102
Transportation	28	28	15	11	66	36	32	26
Material Handling	13	20	18	6	12	8	6	5
Other	255	219	157	91	85	38	22	17
TOTAL	1500	1400	991	660	1188	874	604	495

NUMBER OF UNEMPLOYED REGISTRANTS AT THE REGIONAL MANPOWER CENTRES OF PRINCE RUPERT AND TERRACE, 1979*[2]

Prince Rupert and Port Edward				Terrace Area			
Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.
2135	2383	974	1309	1359	1044	979	785

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*[1] Unemployment Insurance Commission (1980). Statistics do not include persons not available for work due to sickness or disability nor those receiving maternity benefits.

*[2] Employment and Immigration Canada (1980).

TABLE 4.3-6

AVERAGE INCOME IN THE NORTHWEST REGION (BASED ON 1979 INDIVIDUAL TAX RETURNS)*1

	Average Income (Dollars)	Average Income as a Percentage of B.C. Average
British Columbia	13 277	100
Northwest Total	13 880	105
Kitimat - Stikine	13 802	104
Kitimat	15 364	116
Terrace	14 025	106
Hazelton	9 523	72
Stewart	13 189	99
Census Sub-division A	9 098	69
Census Sub-division B	9 452	71
Census Sub-division C	10 904	82
Skeena - Queen Charlotte	13 774	104
Port Edward	13 049	98
Prince Rupert	13 980	105
Sub-division A	9 106	69
Stikine	15 992	120

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*1 British Columbia Ministry of Industry and Small Business Development (1982)

(e) Services and Infrastructure

(i) Transportation

The transportation system is the most important infrastructure element in the region. The marine transport network and the railway have contributed to development. They are still the most important means of transportation and provide the greatest economic impetus in the area. The Prince Rupert area is a complex of harbour facilities providing international, national and regional links with the CN rail and Highway 16. The port has been designated a National Harbour by the federal government with a long-range view to having Prince Rupert develop into the second (after Vancouver) major port complex on the west coast.

The Canadian National railway complements the marine transport system. It provides the only rail access to Prince Rupert via Terrace. Future rail traffic will be influenced by development of the port in Prince Rupert.

At present, the rail line is not operating at full capacity and there is no short-term plan to expand the line except for the construction of an extension from the main track to Ridley Island (Kehoe, pers. comm.).

Another important east-west link between Prince Rupert and the eastern part of the province via Terrace is the Yellowhead Highway. This system is perhaps more important as a passenger route than as a freight route. However, commercial traffic volume has increased in recent years, based on derived statistics over 1975 to 1979 for the area between Prince Rupert and Terrace (British Columbia Ministry of Transportation and Highways 1980a). For most non-bulk cargo, perishable goods and consumer items, trucking is preferred. It offers 1 or 2 day service between Vancouver and Prince Rupert for most goods. Rail and water transport can take more than 2 days. The highway is being upgraded with paving and widening programs. The work is expected to be completed well before the proposed transmission line construction period (British Columbia Ministry of Transportation and Highways 1980b) .

The area is also serviced by scheduled and charter flights, mainly for inter-regional transport. Use of small aircraft is infrequent in the study area, and is mainly for medical emergencies, forest protection or transmission line maintenance. The unfavourable weather conditions which often prevail in the area are a major drawback to air transportation. However, existing transmission lines and towers are not known to have caused aviation problems in the area (Clarke, pers. comm.).

(ii) Local Services and Housing

Prince Rupert, Port Edward and Terrace, the three incorporated municipalities in the study area, are established communities with well-developed social structures and a full range of community services and infrastructure. The communities are governed by elected mayors and councils.

The city of Prince Rupert had a total of 4429 housing units in 1979, up 26 percent from the 1971 stock. Housing starts increased by 25 percent from 420 units in 1975 to 526 units in 1979. In 1976, 57.5 percent of the units were owner occupied. The occupancy rate of newly constructed single family dwelling units (average price $70,000) in 1979 was 80 percent. Rental housing vacancy rates are generally high, in the neighbourhood of 10 percent. This reflects a high turnover, mainly in bachelor and one-bedroom suites. There are two trailer parks in Prince Rupert with 118 and 100 lots. There are no immediate plans for new developments as the existing parks are not fully occupied (City of Prince Rupert 1980).

Residential development in Port Edward has evolved from clusters of fishing company houses around the plants to a concentration along the slopes on the eastern shore of Porpoise Harbour. From 1971 to 1976, housing stock increased 9 percent, from 220 to 260 units. The majority of the increase was in mobile and single family units (Village of Port Edward 1980). Most of the recent new housing units replace old stocks, as demand for housing is low.

Unlike Prince Rupert and Port Edward, most of the recent residential developments of Terrace occur outside the municipality. From 1973 to 1979, the housing starts in the district municipality declined (from 255 units to 136 units) while the neighbouring unincorporated communities absorbed the demand. Although housing requirements in the immediate future can be met by increasing housing density and establishing new residential zones, it is unlikely that land within the municipal boundary will be available to accommodate all projected population growth in the next 10 years (Kerby 1979).

Since 1978, the rental vacancy rate has frequently been zero (Kerby 1979). However, the estimated rate for November 1982 was 15 percent (Greno, pers. comm.)

GENERAL IMPACT ASSESSMENT

SECTION 5.0 - ENVIRONMENTAL SENSITIVITY, MITIGATION RECOMMENDATIONS AND IMPACT ASSESSMENT

SUB-SECTION 5.1 - GENERAL IMPACT ASSESSMENT

Sub-section 5.1 describes the nature of the potential impacts which would be likely to occur if a 500 kV transmission line were located in the study area. This impact potential is called sensitivity (intolerance, unadaptability) and is shown on ten sets of resource maps in Volume II as high, moderate, low or nil. The criteria used to determine the degree of sensitivity which each resource has to such development are discussed in the text.

Mitigation measures which would reduce or alleviate impacts are recommended where appropriate. The criteria for assessing the magnitude of residual impacts on each resource, assuming those mitigation measures are followed, are given in the text. Application of those criteria to site-specific areas along the transmission route is accomplished in Sub-section 5.2. These impacts are also mapped on the resource maps in Volume II.

5.1.1 SURFICIAL GEOLOGY AND HYDROLOGY

(a) Introduction

Terrain sensitivity is defined as the susceptibility of soil and other surficial materials to erosion. Slope gradient, amount of vegetation cover, and the thickness and texture of material overlying bedrock are all major factors in determining terrain sensitivity. However, groundwater and surface water networks and hydrologic regime are factors which must also be considered in assessing the sensitivity of terrain to mass wasting and fluvial erosion processes.

Hydrologic sensitivity consists of the susceptibility of hydrologic features (mainly surface channels) to physical or chemical alteration. However, the main reason for this concern is the desire to protect the fishery resource. In this context, the major hydrologic sensitivity is the possibility of introducing sediment into stream channels because this would have a negative impact on fish (Section 5.1.4).

All hydrologic sensitivities were considered with respect to potential erosion and stream sedimentation, and are therefore combined with the discussions of surficial geology and aquatic resources in Section 5.1. Hydrologic impacts are discussed in the context of fish habitat protection in Section 5.2. For the same reason, there are no separate maps of hydrologic sensitivities and impacts in Volume II.

Engineering hazards (such as potential avalanche, landslide or flood damage to the transmission system) are discussed in this report because they are of environmental concern. This is due to potential terrain disturbance during maintenance operations in response to damage to the transmission system by geologic and hydrologic events. Furthermore, engineering hazards and environmental sensitivities are frequently related to the same terrain features, especially steep hillslopes. Therefore, engineering hazards have been mentioned in some of the segment-specific discussions of sensitivities and they have been considered in evaluating impacts.

(b) Methodology

A combination of existing methodologies was used to rate the sensitivity of terrain to the construction and operation of the proposed transmission line. A system of geologic hazards mapping devised by the British Columbia Resource Analysis Branch (Ryder and MacLean 1980) identifies the geologic processes active within each unit of their terrain classification scheme. However, the mapping system gives no indication of the intensity, frequency or timing of these processes, nor does it permit a rating of an area's potential hazard. This system is compatible with the terrain classification scheme used for the surficial geology maps in this report and is the basis for the sensitivity rating scheme (Table 5.1-1). Elements of a terrain assessment methodology developed by TERA (1975) for the Prince Rupert area, and the identification of terrain hazards in the Terrace area (Clague 1978) have also been incorporated. Portions of terrain units identified as sensitive areas using the criteria listed in Table 5.1-1 are shown on Maps SG-1 through SG-7. Impacts were assigned to segments according to a judgement of mitigation potential and the amount of sensitive terrain traversed as explained in Subsection (d).

(c) Sensitivity

Several terrain types in the Skeena valley are moderately sensitive. The marine sediments in the Terrace area are very fine grained and subject to sheet wash, slope failure and gullying. The introduction of silts and clays into the streams if the stream banks are disturbed can affect aquatic resources (Section 5.1.4).

The active alluvial floodplain of the Skeena River has been uniformly classified as an area of low sensitivity, but there are some sensitive areas, such as unvegetated rapidly migrating channel or point bars. The lower reaches of the Skeena River, particularly within the range of tidal influence, are more dynamic than the upper river reaches near Terrace. Major channel shifts have occurred in the last 30 years, particularly during extreme flood events such as in October 1974. Location of towers near active channels changes the downstream transport of sediment, with increased deposition upstream of towers and increased scour down stream. Also, towers will act as slight impediments to spring ice break-up and the downstream movement of logs and other debris.

Organic deposits, predominantly found in the Prince Rupert area, are developed to great depths and are unsuitable for any construction activity utilizing heavy equipment or requiring disturbance of vegetation. This serious engineering constraint does not necessarily mean that the organic terrain unit has a high or moderate environmental

TABLE 5.1-1

CRITERIA FOR SURFICIAL GEOLOGY SENSITIVITY RATINGS

Landform*[1]	Terrain Map Unit*[1]	Geologic Process*[1]	Additional Criteria *[2]	Sensitivity
avalanche cones, gullies	C a - AV M f - V b v	avalanches (snow), gullying	-	moderate
steep bedrock slopes, cliffs	R s - A - AV - V	rockfall, rockslide avalanching	slopes >35°	moderate
talus slope or cone, rockslide, earthflow or debris flow deposit	C a M h r f v	rockfall, debris flow, bedrock slump	slopes >30°	low
colluvial, morainic fluvial deposits	C v M b F f t	minor slumping	slopes <30°	none
sloping or gullying marine sediments	W m - V v b s	slumps, slides, gullying siltation into streams		moderate
floodplain, alluvial fan	F l - E f b v	bank erosion, sedimentation, flooding	- *[3]	low
organic deposits	O v b		slopes <10°	none
		gullying	slopes >10°	low

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*1 Condensed from Ryder (1980).

*2 Presence and density of surface drainage channels is used as additional criteria in appropriate terrain units.

*3 Inactive portions of the floodplain were judged to have no sensitivity.

sensitivity. Disruption of the ground water table in these areas of poor drainage will have unpredictable but probably no serious impacts on stream flow, siltation and the stability of vegetation types. If the organics are located on a sloping surface, they are susceptible to sheet wash and gullying if disturbed, and are rated to be low sensitivity (Table 5.1-1).

The most common type of sensitive terrain in the study area is the steeply sloping bedrock with thin overburden which is subject to downslope movement processes. Amount of vegetative cover, seismic activity, slope angle and climate are important factors in determining the type and severity of downslope movement. Depending on the type of construction activity planned (i.e. road vs helicopter access), disturbance of the vegetative cover can accelerate the erosional processes. The types of processes involved range from gullying and avalanching to rockfalls, debris flows, slumps and slides (Table 5.1-1).

(d) Impacts

Wherever a proposed route crosses a sensitive terrain unit, the potential for mitigating impacts was considered. Depending on the nature of the terrain sensitivity, the expected impact along a strip within each terrain unit was judged to be equal to or less than the sensitivity of the unit. For example, where a route crosses moderately sensitive terrain, the impact on a strip within that unit was assigned a magnitude of moderate, low, or nil. In cases where impact was assigned a lower magnitude than the level of sensitivity, this was based on: 1) site-specific mitigative measures; or 2) assumptions of careful practices which include right-of-way location, means of access, tower site selection, clearing, and construction. The latter criteria apply to the channel bar and island terrain in the Skeena River which is almost all mapped low sensitivity and no impact. The impact of disturbing these active fluvial terrain units is recognized in the context of fisheries impacts as discussed in Sections 5.1.6 and 5.2.

In some areas (e.g. Prudhomme, Lachmach, and Telegraph segments) the presence of a gas pipeline or the existing 287 kV line provided examples of impacts due to linear developments. Hydrologic impacts were assessed only in the context of fisheries and are therefore discussed in Section 5.1.4 and Section 5.2. Site specific mitigation of terrain impacts are discussed in Section 5.2.

Impacts within each segment are summarized in Table J-1 which lists the lengths of the transmission line along which there would be low or moderate terrain impacts. No segments are expected to have high impacts. Table J-2 compares the total impacts of route alternatives and ranks each alternative in order of preference. Segments and route alternatives are given impact ratings based on the highest impact ratings within the respective segment or route alternative.

5.1.2 VEGETATION

(a) Methodology for Sensitivity Ratings

The sensitivity of vegetation to construction and operation of a transmission line is determined by both the importance of vegetation types affected and by their tolerance to development. Importance of vegetation types can be gauged by weighing several intrinsic factors of each type. A vegetation type is considered significant if it occurs infrequently in the study area, has both high floristic and community diversity, includes rare or endangered species, is highly productive and/or is visually attractive (Table 5.1-2). Tolerance to development is the degree to which a vegetation type would be permanently altered by a given development. Logging, clearing and the construction of access roads are the major sources of potential impacts to vegetation from transmission lines.

Sensitivities of vegetation types in the study area are illustrated in Maps VG-1 to VG-7.

TABLE 5.1-2

CRITERIA FOR DETERMINING SENSITIVITY OF VEGETATION TYPES[*1]

Vegetation Types	Occurrence of Type*2 (1 frequent - 4 infrequent)	Floristic Diversity (1 low - 4 high)	Community Diversity (1 low - 3 high)	Productivity (1 low - 4 high)	Occurrence of Rare Species (1 low - 4 high)	Visual Attractivity (1 low - 4 high)	Tolerance to Development (4 low - 1 high)	Total	Sensitivity Rating*3
Low salinity tidal marsh	4	4	2	4	4	3	3	24	High
Bog-muskeg	1	4	3	1	4	4	4	21	High
Coastal forest	1	1	2	2	1	2	2	11	Low
Alluvial forest	2	3	2	3	3	3	3	19	Moderate
Successional vegetation	1	3	1	3	1	1	1	11	Low
Freshwater aquatic communities	1	4	3	2	4	4	3	21	High
Black cottonwood forest	1	1	2	3	1	2	2	12	Low
Pine forest	4	2	2	2	2	2	2	16	Moderate
Montane forest	1	2	3	2	2	4	3	17	Moderate

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*1 These criteria are adapted from suitability ratings developed by TERA (1975).

*2 These ratings were based on occurrence of each type in the study area with boundaries extended from valley bottom to ridge tops.

*3 High scored 20 or more points; moderate - 15 to 19 points; low scored 14 of less points.

Tidal marsh, bog-muskeg and freshwater aquatic communities are the most sensitive of the vegetation types in the area. They have high floristic diversity, visual appeal and rare species. They are also relatively sensitive to development. Access roads, for example, could affect much of the plant community through changes in drainage patterns, thus affecting much more area than that taken by the road. The removal of roads and construction sites and attempts at restoration of original communities would be less successful than in the more adaptable forested sites.

Alluvial, pine and montane forests are considered moderately sensitive. They commonly exhibit diversities, productivities and development sensitivities which are average or moderate. Revegetation to natural communities after disturbance is usually possible within 10 to 20 years.

Coastal, black cottonwood and successional forests have low sensitivity because they have low numbers of endangered species, generally low floristic diversity (except in early successional forests) and occur often in the study area. Disturbed sites can be returned to their original species composition fairly easily in less than 15 years.

(b) Possible Mitigating Measures Including Vegetation Management

A transmission line development requires that a right-of-way be cleared of all tall-growing vegetation and maintained with low-growing vegetation. Most of the study area is densely forested, but there are also areas of sparsely treed bogs, especially in the western portion.

The methods used in clearing an area will partially determine the nature of vegetation control during the life of the project. The desirable method is one which achieves effective control over time and is environmentally acceptable. Improved control of tall-growing species can be accomplished by encouraging the competing growth of shrubs and, in some cases, sod-forming grasses (U.S. Department of Agriculture 1965, Bramble and Byrnes 1974, Niering and Goodwin 1974).

An effective way of ensuring healthy growth of competing species is to leave them intact by selective or hand clearing. Not all vegetation types have dense or even partial shrub cover: some plant communities in the pine and coastal vegetation types, for example, have sparse understories and would not benefit as much from selective or hand clearing. Most other types have shrubby growth which should be left during clearing. This practice will lessen the impact on vegetation and decrease the need for maintenance measures such as herbicide application. Wildlife will also benefit from shrubby species, and soils will be left largely undisturbed. Hand clearing of the right-of-way is recommended in all areas where shrub growth is well-established as well as in sensitive areas around watercourses (including the Skeena River islands) and in bog-muskeg areas. These areas would be identified by a biologist or vegetation management officer during or after centreline survey.

Selective clearing has been practiced by U.S. utilities such as Metropolitan Edison and in combination with selective maintenance techniques has resulted in extension of the periods between maintenance. For example, while the right-of-way area doubled over a 16-year period, the number of acres needing treatment annually has remained constant (Ulrich 1976).

The access roads associated with transmission line construction and maintenance can have greater impacts to vegetation than the transmission line itself. If the roads are permanent, vegetation communities are lost completely. This impact is compounded if a number of construction contractors all build separate, though perhaps temporary, access roads. It is very important to design a multi-purpose access route which all contractors must use. This will decrease the loss of plant communities which are valuable wildlife shelter, and aid in erosion prevention and fisheries protection.

An additional problem occurs in wetland areas where access roads act as dams which impede normal water flow and seepage. Abnormal flooding or draining in any of the bog-muskeg areas along the route could be detrimental to vegetation communities (Boelter and Close 1974). The problem could be important along the lower Skeena where the river is under tidal influence and bog wetlands occur nearby. Interference with freshwater flow can cause brackish water intrusion and subsequent alteration of plant communities (Darnell 1976). Where access roads must be maintained in wetlands, frequent cross drainage should be installed to maintain existing drainage and vegetation.

Vegetation control during the operation of the transmission line is usually accomplished by a variety of methods such as herbicide application, grooming, seeding, mowing, pruning or slashing. Herbicide application may be accomplished either by broadcast treatment (usually by air) or selective treatment methods. The major problem with aerial broadcast application of liquid herbicides on transmission rights-of-way is that it is difficult to avoid drift injury to adjacent areas. Aerial spraying is thus not recommended. Aerial application of granular herbicides is not recommended in the Skeena-Rupert area as it would result in destruction of desirable plant species which resist the growth of tall-growing vegetation and which provide food and protection for wildlife (Niering and Goodwin 1974, Galvin et al. 1979).

Selective herbicide methods such as basal treatments, which kill only target species (Gardner 1976, Carvell 1976), are recommended where herbicide use is necessary. Spot treatment of hardwood stumps soon after clearing is recommended to prevent sprouting. It is recommended that in tidal marshes, aquatic and bog-muskeg vegetation types, and skunk-cabbage associations within the alluvial forest vegetation type, only highly site-specific herbicide application techniques be used such as capsule injections of the tall-growing species. No herbicides would be used within 10 m of waterbodies.

Grooming, seeding and mowing are vegetation maintenance methods which are most often used on flat or gently sloping areas with access where mechanized equipment can be operated. Seeding can be done by hand or air in all areas. Grooming involves log and stump removal and discing. It is generally most useful in agricultural areas and is not recommended in forested areas where shrub growth is desirable.

Seeding to grasses is recommended on slopes and near watercourses where erosion prevention is a major concern. Native grasses are preferred in forested areas to prevent agronomic species from invading and outcompeting existing plant communities. Experimental plantings of native shrubs should be encouraged in flat areas whose soils, slope position and surrounding native vegetation indicate that such plantings might be successful. A list of shrubs to be considered in forested vegetation types is found in Table 5.1-3.

Mowing is generally not recommended, as all plant growth is cut regardless of its utility to wildlife. However, it is a useful method where basal-sprouting browse species are abundant, and where shade intolerant tall-growing deciduous species may be suppressed by fast-recovering low ground cover.

Pruning and hand slashing are selective techniques which remove or alter undesirable tall-growing species and allow others to proliferate. Periodic treatment neither disturbs soil and ground cover nor involves pesticide use. For these reasons it is the recommended maintenance method in bog-muskeg areas and near streams and watercourses. In forested areas it should be considered in conjunction with other selective management techniques. Tall-growing coniferous species may be controlled by cutting below the lowest whorl of branches. However, because slashing causes some tall-growing deciduous species to proliferate, site specific herbicide injection or stump treatment may be the only effective control for tall-growing deciduous plants.

TABLE 5.1-3

NATIVE SHRUBS USEFUL IN VEGETATION MANAGEMENT ON TRANSMISSION LINE RIGHTS-OF-WAY

Vegetation Type	Shrub	Usual Maximum Height (m)
Bog-muskeg	Labrador tea	1
	bog laurel	<1
	wild cranberry	<1
	dwarf azalea	1
	bog blueberry	<1
	lingonberry	<1
	sweet gale	1
	bog rosemary	<1
	dwarf blueberry	<1
	crowberry	<1
	spreading juniper	1
Coastal forest	salal	3
	false azalea	2
	oval-leaf huckleberry	2
	red huckleberry	2
	Alaska blueberry	<1
	devil's club	3
	salmonberry	3
	stink currant	3
	big huckleberry	2
	strawberry bramble	<1
Alluvial conifer forest	devil's club	3
	salmonberry	3
	red elderberry	6
	oval-leaf huckleberry	2
	Alaska blueberry	<1
	black twinberry	3
	salal	3
	red-osier dogwood	6
	false azalea	2
	high-bush cranberry	2
	stink currant	3
	red huckleberry	2
Successional forest	any shrubs normally occurring in the area before disturbance, e.g. blueberries, huckleberries, salal and elderberry	
Black cottonwood	red-osier dogwood	6
	salmonberry	3
	thimbleberry	1.5
	devil's club	3
	red elderberry	6
Pine forest	false azalea	2
	big huckleberry	2
	red huckleberry	2
	twin flower	<1
Muntane communities	oval-leaf huckleberry	2
	Alaska blueberry	<1
	false azalea	2
	copper bush	2
	Sitka mountain ash	3

In successional forests, little clearing may be necessary due to recent logging. If regeneration has begun, tall-growing species will need to be eradicated at the time of construction to encourage growth of low-growing species which can successfully inhibit new tree growth.

Vegetation management (Table 5.1-4), the combination of both selective clearing and selective maintenance, to eradicate tall- growing species but maintain desirable low growth is the recommended strategy for minimizing impacts on vegetation. The general principles espoused in the vegetation management section of the Cheekeye to Dunsmuir Route Selection Study (Beak Consultants Limited and Associates 1979) are endorsed. This strategy and all other recommendations in this section are general. The environmental officer, vegetation management officer and district transmission supervisor should have input into the clearing specifications to delineate in more detail the tree and shrub species which should be retained in the clearing stage. These staff should also monitor both the initial treatment of stump and root-sprouting species and the revegetation of disturbed land with suitable species. The subsequent maintenance carried out by regional production staff should follow the recommendations herein and should be periodically monitored to determine the success of the proposed strategy.

(c) Impact Assessment

The criteria used in determining impacts appear in Table 5.1-5. It is assumed that mitigation measures including the vegetation management recommendations in the previous section will be followed. The permanence of the residual impact was the major determinant of the degree of impact. If little mitigation is possible, impact ratings are similar to sensitivity ratings. If mitigation will gradually return the area to its original plant communities, impact is considered moderate. If mitigation can return the areas to original communities fairly quickly (within 15 years), impact is considered low. Where new permanent access roads are to be constructed impact ratings remain at the same level as sensitivity ratings.

TABLE 5.1-4

VEGETATION MANAGEMENT STRATEGY[*1]

Typical Area	Clearing and Construction Activities[*2]	Early Maintenance Period (5 to 10 years)	Long-term Maintenance
Canyons, gullies	leave all vegetation intact	no treatment	no treatment
Edges of waterbodies, Bog-muskeg	thin overstory, no herbicides	hand-slash tall-growing species, no herbicides within 10 m of water-bodies except stem injection techniques	hand-slash tall-growing species
Road crossings in forested areas	top overstory	prune tree side growth, encourage low-growing species	prune larger trees (top and sides)
Forested area with merchantable timber, Area not used heavily or seen readily by public, and/or unstable soils	remove overstory, recover merchantable timber, leave understory intact[*3], leave roots and clearing debris, seed or plant any open ground (similar to B.C. Hydro Clearing Standard A-1)	use site-specific techniques for tall-growing species, e.g. injection, stump treatment, slashing, etc.	spot-eradicate tall-growing species, remove danger trees
Forested area with merchantable timber, visual concerns and stable soils	remove overstory, recover merchantable timber, leave understory intact[*3], leave roots but remove debris seed or plant any open ground (similar to B.C. Hydro Clearing Standard B)	same as above	same as above
Non-merchantable forest area, Unstable soils, No visual concerns	remove overstory, leave understory intact[*3], leave all debris (similar to Standard A)	same as above	same as above
Non-merchantable forest area, Unstable soils and visual concerns	remove overstory, leave understory intact[*3], leave roots but remove debris seed or plant any open ground (similar to Standard B)	same as above	same as above
Forest land, Few seed trees, no existing shrub layer, gentle slope, stable soil, good possibility of native ground cover establishment	remove overstory, recover merchantable timber if any, leave roots debris can be piled and burned, allow natural regeneration	use site-specific techniques for tall-growing species, plant or seed and fertilize areas with no regeneration	same as above
Forested area, No existing shrub layer, gentle slope, stable soils, Many seed trees present	remove overstory, recover merchantable timber if any, leave roots seed or plant with native species	same as above	same as above

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*1 Adapted from Beak Consultants Limited and Associates (1979).

*2 Planting and seeding with native species should be done around tower sites, materials sites, cable-pulling sites, skid trails and so on.

*3 Understory should be left as intact as possible, recognizing that some tall understory may have to be removed, and that some understory may be damaged when larger trees are felled or removed.

TABLE 5.1-5

CRITERIA FOR VEGETATION IMPACT RATINGS

Impact Rating	Activity/Vegetation Types	Segments
High	New permanent access roads required in high sensitivity types, i.e. tidal marsh, bog-muskeg, or freshwater communities. Any heavy equipment use, spur road or tower construction occurs in tidal communities.	More than 30 percent or 3 km of a segment (whichever is less) includes high impact areas
Moderate	Heavy equipment use, spur road tower construction (other than permanent access) occurs in high sensitivity vegetation types but vegetation management recommendations are capable (over time) of returning areas to natural vegetation. New permanent access roads are required in moderate sensitivity types, i.e. alluvial, pine, or montane forests.	Less than 30 percent or 3 km of a segment includes high impact areas, but the total length of high and moderate impact areas is at least 30 percent or 3 km of the segment.
Low	All other impacts to native vegetation communities.	All segments with at least 30 percent of their length (or 3 km) in native vegetation which are not rated high or moderate overall.
Nil	No native vegetation communities are affected.	Segments which have less than 30 percent (or 3 km) of their length in native vegetation and do not fit into above descriptions.

Construction camps and materials sites should be located in low sensitivity areas if previously cleared areas are not available.

5.1.3 WILDLIFE AND WILDLIFE USE

(a) Introduction

The introduction of a transmission line and right-of-way corridor can affect wildlife in a variety of ways. During the construction period, most effects are linked to the influx of people and machinery. During operation the transmission line represents a restructuring of the natural habitat. The vegetation community is usually maintained in an altered condition. Towers, conductors and associated electro-magnetic fields have been added to the environment. These changes may affect wildlife species adversely or beneficially and mitigation can often minimize adverse impacts. As with all man-induced changes in ecosystems, there is a possibility of complex and unanticipated results. In light of man's previous experience with transmission lines, it seems likely that such consequences will be minimal.

Transmission lines may affect human use of wildlife resources either by affecting the activity (e.g. the wilderness experience of hunting or wildlife photography and viewing), or by affecting abundance and distribution of the target species.

The proposed route was rated for sensitivity with respect to wildlife (Maps WL-1 to WL-7). Sensitivity ratings took into consideration the importance of the resource, and the severity of the damage that could result from the transmission line in the absence of mitigation. The criteria used to determine sensitivity ratings for map areas where only one factor was significant are given below (Table 5.1-6). In intermediate cases, or where more than one factor was significant, a site-specific judgement of the appropriate rating was made. Usually, a combination of factors resulted in a higher rating. For example,

TABLE 5.1-6

CRITERIA FOR RATING WILDLIFE SENSITIVITY AND MAP AREA IMPACT*[1]

Low Sensitivity

Potential calving habitat for moose;
mild-winter range for moose (except where major disturbance already exists);
areas adjacent to mountain goat habitat;
slight collision hazard for waterfowl and/or eagles;
deer habitat without existing access.

Moderate Sensitivity

Mild-winter range for moose with especially good cover, or severe-winter range with little cover;
areas where changes in access or visibility would significantly increase hunting pressure on moose;
moderate collision hazard for waterfowl and/or eagles;
minor wetlands.

High Sensitivity

Severe-winter range for moose;
mountain goat habitat;
trumpeter swan habitat (except where topography reduces collision hazard);
high collision hazard for waterfowl and/or eagles;
major wetlands.

Low Impact

Areas where changes in access or visibility would moderately increase hunting pressure on moose;
severe-winter range for moose with little cover;
mountain goat habitat and adjacent areas potentially affected by construction activities;
moderate or low collision hazard for waterfowl and/or eagles;
low collision hazard for trumpeter swans;
deer habitat without existing access;
wetlands;
construction camp areas in mild-winter moose range.

Moderate Impact

Areas where changes in access or visibility would greatly increase hunting pressure on moose;
patches of good cover in mild-winter range;
high collision hazard for waterfowl and/or eagles;
construction camp areas in severe winter range for moose;
mountain goat habitat potentially affected by minor changes in access or visibility.

High Impact

Severe-winter range for moose with good cover;
high collision hazard for trumpeter swans.

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*1 See 5.1.3(a) for a discussion of the rationale for segment impact ratings.

areas that were mild-winter range and potential calving habitat for moose were rated moderate rather than low in sensitivity.

The proposed routes were rated for expected impact, if mitigative recommendations are followed. Criteria used to determine impact ratings for map areas are given above (Table 5.1-6). In intermediate cases, or where more than one factor was involved, site-specific judgements were made.

Impact ratings for segments were judgements based on impact ratings for map areas. They took into account the nature, severity and time span of the anticipated impact and the area that would be affected.

The following section and Section 5.2 include recommendations to mitigate adverse impacts on wildlife. Because of the objectives and scope of the study, these recommendations are general. In areas identified as moderate or high in sensitivity for wildlife, site-specific decisions regarding the route and construction should be made in consultation with a wildlife biologist.

(b) The Construction Phase

(i) Noise and Human Activity

The activity of humans and the noise of machinery during construction may cause stress, avoidance and disruption of normal wildlife movement patterns. Under most conditions, construction activity is not likely to affect wildlife populations significantly. However, disturbance can be a major mortality factor during certain seasons or stages in the life cycle (Geist 1978).

In regions of heavy snowfall, winter is typically the season in which ungulates are most vulnerable to disturbance. At this time forage intake is reduced, the energy cost of movement is increased and the animals lose weight. Disturbance places an additional metabolic demand on the animals, which are already expending more energy than they are taking in. Furthermore, human activity on a desirable winter range may displace ungulates to less suitable areas, where their chances of survival are poorer.

The possibility of disturbance during construction is a major factor in determining sensitivity ratings for range used by moose in severe winter weather and is also considered in determining ratings for mild winter range. Throughout the winter range of moose, the adverse effects of disturbance should be mitigated by avoiding construction activity from early December through April. Impact ratings are based on the assumption that this recommendation is followed.

In the case of an unusually mild winter, such as the winter of 1980/81, constraints on winter construction in moose habitat could be modified. Such a decision should be made by a wildlife biologist in consultation with regional staff of the Fish and Wildlife Branch.

Ungulates are also vulnerable to disturbance during the period of late pregnancy and parturition. Moose are thought to use the islands of the Skeena for calving (Caw, Crack, pers. comm.), though no data have been collected on calving areas. Cow moose may remain on these islands after winter until their calves are born in late May to mid-June. All vegetated islands between Selma Island and Terrace should be viewed as potential calving habitat. Construction should be avoided at least from the last week of May through June and preferably during the period between winter and calving as well. If these constraints on timing of construction are unacceptable, additional fieldwork should be funded to identify calving areas more specifically. In determining impact ratings, it was assumed that these recommendations would be followed.

Deer are believed to move out of the study area during periods of heavy snow and are probably widely dispersed at fawning time (Escott, pers. comm.). Their sensitivity to disturbance in the study area is considered low and no mitigation is recommended.

Mountain goats are highly vulnerable to disturbance by humans; over-winter survival, reproductive success, and recruitment of young may be affected by harassment (British Columbia Fish and Wildlife 1979d). No goat populations occupy areas crossed by any of the proposed alignments, but some adjacent mountainsides and rock bluffs support goats. Although ground activities are not expected to affect goats, there is a significant hazard of harassment from helicopters travelling to and from construction sites. This factor is heavily weighted in determining sensitivity ratings. Construction requiring helicopters on sites adjacent to goat populations should be avoided from December through 15 June; this period includes winter, late pregnancy and birth of kids. At all times, helicopter routes should be planned to avoid passing near goat habitat. In rating impacts, it was assumed that these recommendations would be followed, but that some inadvertent disturbance from helicopters would occur.

Waterfowl are especially vulnerable to disturbance during spring migration and the breeding season. In spring, migratory waterfowl are concentrated in areas offering suitable habitat and ice-free water; if they are disturbed they may be forced into marginal habitat. This is also true of wintering areas. As few waterfowl nest in the study area, disturbance during the breeding season is relatively unimportant. Possible disturbance of migratory birds during construction is a factor in rating sensitivities. In migratory waterfowl habitat, construction should not take place during spring migration, 15 March through 15 May. Impact ratings are based on the assumption that this recommendation is followed.

In addition to disturbance, some individual animals will experience destruction of nests or dens during the construction phase. This is not likely to affect wildlife populations, but may concern the public if conspicuous species are involved. Destruction of eagle nests, for example, should be avoided if possible. It is technically feasible to move eagle nests (Postovit et al. 1982); this should be considered in sensitive areas. Nest locations are not considered in sensitivity or impact ratings.

Much of the transmission line route is located near the river, in habitats preferred by black and grizzly bears. Encounters between bears and humans are potentially dangerous to both species. Careful garbage disposal around construction camps is the best deterrent to bear problems. The safest policy is to incinerate garbage and to locate sites for solid waste disposal several kilometers from camps. Bear/human interactions are not considered in sensitivity or impact ratings.

(ii) Increased Hunting Pressure

During the construction phase, the influx of workers and the improved access may result in increased hunting pressure on wildlife. This is especially likely along new roads and near construction camps. Most game species in the area are expected to tolerate such a temporary increase, but there is a risk to mountain goats.

Goats have a low reproductive potential and are extremely vulnerable to overhunting. During previous construction activities in the lower Skeena, helicopters were used to locate goats for hunting, with devastating effects on some populations (Crack, pers. comm.). Helicopter travel routes during construction should be planned to avoid passing near goat habitat.

The effects of increased hunting pressure during construction were considered in determining sensitivity and impact ratings in goat habitat and near construction camp locations.

(c) The Operation Phase

(i) Field Effects and Audible Noise

Energized high-voltage transmission lines produce electromagnetic fields. Experimental evidence indicates that fields of this type can produce a variety of biological effects in subjects exposed to them (Phillips and Kaune 1977, Marino and Becker 1978, Ellis et al. 1978). Whether or not actual transmission lines produce adverse biological effects is unclear. Some experimental results have been contradictory, or have been interpreted in contradictory ways by different scientists. The present state of knowledge does not permit an assessment of the impact of the electromagnetic field of transmission lines on wildlife.

Energized transmission lines also produce audible noise, due to the ionization of air (corona) around the conductors. The intensity and frequency composition of audible noise varies with a number of factors, one of which is weather. Effects of audible noise on wildlife have not been demonstrated, although masking of communication signals, interference with predator-prey relationships and even hearing impairment in tower-nesting birds have been suggested as possibilities (Ellis et al. 1978, Lee and Griffith 1978).

Despite the suggested hazards of audible noise and the electromagnetic field wildlife species utilize transmission line corridors that meet the animals' habitat requirements. Lee and Griffith (1978) observed birds perching and nesting along rights-of-way and in towers, even during rainstorms when audible noise levels reached maximum values. Goodwin (1975) compared big game behaviour on a 500 kV transmission line corridor in Idaho and in nearby control clearings and concluded that the energized transmission line did not affect wildlife movements.

Field effects and audible noise are not considered in the sensitivity and impact ratings.

(ii) Effects of Towers and Conductors

The presence of towers and conductors in the airspace may have both negative and positive impacts on birds.

There is risk of death or injury to flying birds through collision with towers and conductors. In a nationwide study in the United States, 0.07 percent of the nonhunting mortality of waterfowl resulted from collisions with power lines (Stout and Cornwell 1976). Where transmission lines crossed a slag pit heavily used by waterfowl, 0.2 to 0.4 percent of the birds present were killed annually by collisions (Anderson 1978). In the case of most waterfowl species, this level of mortality has no biological significance, in the sense that it is far below the compensatory response capability of populations and would not result in population decline (Thompson 1978). It may have social significance when people see the dead birds and become concerned.

Collision mortality may have biological significance in small populations of vulnerable species (Willard 1978). Thirty-seven percent of the known mortality in a greater sandhill crane population (Drewien 1973) and 38 percent of the mortality in a swan population (Owen and Cadbury 1975) was attributed to collisions with power lines. In Michigan, 30 mute swans died from power line collisions over 15 years; the population dropped from approximately 70 to 24 during this period (Sisson 1975).

Species differ in their susceptibility to power line collisions. Swans and cranes are among the species over-represented in reports of collision mortality, presumably because of their great size, low maneuverability and flocking behaviour. Raptors are susceptible to collisions when they are hunting, or otherwise distracted (Thompson 1978, Willard 1978).

Other factors predisposing wire strikes include poor weather, which reduces visibility and causes birds to fly low (Thompson 1978) and the presence of lightning shield wires. Most reports agree that shield wires, which are higher and narrower than conductors, cause more collisions (Meyer 1978, Report of Mitigation Working Group 1978, Thompson 1978). Collisions with conductors also occur; Anderson (1978) observed nine collisions, of which eight involved conductors and only one a shield wire. The reasons for the greater impacts of conductors than shield wires in Anderson's study are not apparent. However, it is clear that the risk of collision is reduced, usually greatly, by the elimination of shield wires. As B.C. Hydro uses shield wires only in the proximity of substations, the potential for collision mortality in the study area is lower than it would otherwise be.

In the study area, wire strikes are a hazard to some birds. Frequent precipitation and fog create conditions conducive to collisions. Proposed routes cross several wetlands and tidal flats where waterfowl congregate during migration. Trumpeter swans, a vulnerable species, winter in flocks in areas crossed by the proposed line. Swan mortality due to wire strikes has been reported near Kitimat, about 50 km south of Terrace (Crack, pers. comm.). Because of their high susceptibility to collisions, small population size and low reproductive potential, the impact of wire strikes on trumpeter swans could be severe.

Transmission lines pose a hazard to bald eagles as well. Eagles have been reported to strike transmission lines when the eulachon are concentrated along the lower Skeena during the spring run (Escott, pers. comm.).

Collision hazards may be mitigated in several ways in addition to elimination of the shield wire. Wetlands, tidal flats and other areas when waterfowl congregate should be avoided if possible. In sensitive areas, collisions may be reduced by locating lines adjacent to tall trees, hills, or other conspicuous objects; birds fly high to avoid these visible features. In steep-sided river valleys, lines should be located parallel rather than perpendicular to prevailing winds, if possible.

Where more than one transmission line is required, clustering them is thought to be less hazardous than scattering them, especially if the heights of the wires are similar (Thompson 1978). In this case, the effectiveness of clustering as a mitigation measure is uncertain, as the 500 kV conductors will be higher than the 287 kV conductors. Where transmission lines must cross sensitive areas, the visibility of wires may be increased by attaching conspicuous objects to them. Advantages and disadvantages of various devices were discussed by Thompson (1978); most are only effective in daytime. This is a serious drawback, as some birds (e.g. swans) are active during night as well as day.

Collision hazard is considered a moderately important factor in determining sensitivity ratings, but is weighted more heavily in areas used by swans. Impact ratings are based on the assumption that mitigation recommendations will be followed where feasible. In some cases, little mitigation is possible other than avoiding sensitive areas.

Transmission towers have been used extensively as nesting and perching sites for raptors and raptor density may be significantly greater near transmission lines than further away (Nelson 1975, Stahlecker 1978). These effects are probably greatest in open areas where perching and nesting sites are limited, rather than in forests. In the study area, the transmission towers would probably be used by eagles as perch sites where the lines cross rivers, wetlands, and other open areas, but the availability of more perch sites is not likely to affect eagle numbers.

(iii) Access and Visibility

Roads built for construction or maintenance are used by the public and may provide access to areas which previously received little use. In suitable terrain, even rights-of-way without access roads may be used by off-road vehicles. Visibility of game animals is increased along transmission line corridors, especially if vegetation is low. The result may be an increase in hunting pressure and hunting success (Goodwin 1975).

The proposed transmission line would create little new access that would significantly affect wildlife. There is a road on the south side of the Skeena between Terrace and Dasque Creek and no new access would be needed. Elsewhere on the south shore the corridor could be reached only by boat. On the north side of the river, the proposed line parallels Highway 16 and is almost entirely within the associated 0.4 km No Shooting Area except along the north side of the Shames flats. The Antigonish-Lachmach valley is presently accessible by logging road. The only large area where new access might occur is in the Prudhomme Lake segment, between Work Channel and Highway 16. This could result in increased hunting pressure on the local deer population, already thought to be in decline. In determining sensitivity and impact ratings, access is considered important only in the Shames and Prudhomme areas.

(iv) The Vegetation Community

The greatest long-term effects of the transmission line on wildlife occur because of the restructuring of the vegetation community. The nature of this restructuring varies according to the techniques of vegetation management used in clearing and maintenance. The response of wildlife species to alterations in the vegetation community depends mainly on their requirements for food and cover.

Removal of the forest canopy typically results in increased production of herbs and shrubs (Bunnell and Eastman 1976). This increase in forage productivity, especially of shrubs, could be a significant benefit to moose and deer. However, preferred browse species may not be used by ungulates if suitable cover is not available (Cavanagh et al. 1976). For moose, shrubs taller than about 2 m are valuable as security cover, but shrubs over about 3 m are unavailable as browse. For deer, shrubs are valuable as cover at about 1 m and out of reach at about 2 m. Vegetation pattern is also important. There is evidence that treatments that create a fine-grained mosaic of cover- and food-producing patches are preferred by moose (Bunnell and Eastman 1976). Cavanagh et al. (1976) also recommended the clumping of vegetation in patches to increase diversity and edge effect.

In addition to security cover, ungulates may require cover as shelter from the weather. Closed-canopy coniferous forests intercept precipitation and reduce the severity of cooling by radiation (Bunnell and Eastman 1976). These factors are especially important in severe winter weather. A cleared right-of-way reduces the value of an area as physical shelter for moose or deer during periods of heavy snow or low temperatures.

Creation of a corridor through a forest results in a new and distinct small mammal community (Schreiber et al. 1976). Species that depend on resources characteristic of mature forests, such as cavities for nests or conifer seeds for food, will decline or be excluded from the right-of-way. Examples include the red squirrel, the flying squirrel. and the marten. Soutiere (1979) found that marten used commercially clearcut areas only one-third as much as undisturbed forests and most of this use was concentrated in residual timber. Other species, such as mice that consume seeds of herbs and shrubs, are likely to increase in numbers. A special habitat is created along the interface between right-of-way and forest.

Some mammals, such as the red fox, are especially adapted to forest edges. Schreiber et al. (1976) found more mammal species in edge habitats than in either forests or rights-of-way.

Bird communities, like mammal communities, are affected by changes in vegetation structure. Some, especially canopy-foraging species, may disappear from the right-of-way and some new species may appear (Anderson 1979). Blue grouse numbers are likely to increase, due to increased breeding habitat. Relatively high species diversity is probable in a right-of-way maintained at an early successional stage (Bunnell and Eastman 1976).

Where rights-of-way cross wetlands, special impacts on wild life may occur (United States Fish and Wildlife Service 1979). As some wetlands are small, direct loss of habitat through placement of tower pads, access roads and equipment landings may be significant. Furthermore, these features may act as dams, causing changes in water levels and flow regimes. Any such changes can have long-term effects on the emergent vegetation. Wetlands provide habitat for waterfowl, moose (in summer), beaver, muskrat, mink, a variety of small birds and mammals and amphibians. All of these could be adversely affected by changes in water levels or vegetation in wetlands.

Vegetation management in the proposed right-of-way offers opportunities for mitigation of adverse impacts and for enhancement of wildlife habitat (Subsection 5.1.2(b)).

In areas used by moose under mild winter conditions, the development of a shrub community in the right-of-way would provide foraging and security cover. A management strategy aimed at herbaceous cover offers little to moose. Clearing and control techniques that encourage basal sprouting, such as hand slashing, mowing and some types of herbicide application, may be used to encourage shrub development (United States Fish and Wildlife Service 1979).

Areas used by moose during severe winters should be avoided wherever possible. In these areas, removal of the forest canopy would have adverse effects which cannot be mitigated. The creation of additional forage does not offset the loss of cover. Severe winter range for moose is considered highly sensitive.

Deer may benefit slightly from increased forage in rights-of-way, but less so than moose. Deer probably do not winter in the proposed corridor and removal of the forest canopy is not a winter range factor.

Wetlands should be avoided or spanned wherever possible. If they cannot be avoided, then a strategy of minimizing disturbance to soil and vegetation should be adopted. If access roads must be maintained in wetlands, then provision should be made for cross-drainage. Wetlands are considered highly sensitive and the impact of disturbance can be only partially mitigated.

(d) Commercial and Subsistence Wildlife Uses

(i) Trapping

In the Skeena valley, marten, fox, wolverine, beaver and otter have brought the greatest economic return to trappers. Wolverine occur mainly outside the proposed transmission line route. The fox adapts readily to clearing by man and might benefit from the creation of new forest edge. Otters are unlikely to be affected by the transmission line unless fish populations are reduced. Some loss of beaver habitat may occur, but it is not likely to be great if mitigation recommendations for wetlands are followed. The marten is the only economically important furbearer in the study area whose habitat would be severely degraded along the right-of-way. As the amount of marten habitat within each trapping area is large compared to the area potentially occupied by the right-of-way, it seems unlikely that trapper returns would be significantly affected. Trappers should be given the opportunity to comment on the proposed route, as there could be significant effects on trapping in individual cases. The B.C. Hydro Registered Trapline Program is available to compensate trappers who are adversely affected by the transmission line.

(ii) Guiding

Potentially, a transmission line could affect the local guiding industry in two ways: by reducing big game populations and by lowering the wilderness quality of the area.

The species most consistently harvested by guided hunters, black bear, is not likely to be affected by the transmission line. Grizzly bears, goats, wolves and moose have also been taken. Of these species, moose could be significantly affected by the transmission line because the Skeena valley is winter range for animals inhabiting the surrounding area. Negative impacts on moose populations should be minor if mitigation recommendations are followed.

Wilderness quality is a valuable feature of a guiding area and is adversely affected by developments such as transmission lines. In the case of the lower Skeena, the wilderness qualities of the valley itself have already been eroded by other developments and a second transmission line will not have much additional impact.

In summary, the proposed transmission line is not expected to have any significant effects on the guiding industry, provided that wildlife mitigation recommendations are followed.

(iii) Subsistence Hunting

As subsistence hunting is believed to be minimal in the study area, no impact from the proposed transmission line is anticipated.

5.1.4 AQUATIC RESOURCES

This section briefly describes the more significant types of potential impact of the project on the aquatic environment and the most sensitive fishery resource areas along the routes. Measures to mitigate impacts are recommended.

(a) Potential Impacts

Logging, clearing and road building to or along the transmission line right-of-way can be expected to cause soil erosion and the input of silt to nearby waterbodies, especially on sections of the route where construction of new access roads will be required (Anderson 1954). Road construction can result in significant deposition of sediment on salmon spawning beds (Burns 1970, Moring 1975), thereby reducing the rate of intragravel flow and consequently the egg-to-fry survival of salmon and trout (Phillips et al. 1975, Slaney et al. 1977a). Abundance and production of benthic insects, the principal food source for juvenile salmonids in streams, may also be reduced by suspended or deposited sediment (Tebo 1955, Slaney et al. 1977b). Sediment deposition in the pools of a stream has been observed to adversely affect trout carrying capacity (Saunders and Smith 1965).

Impact from sediment input to streams is primarily of concern during or immediately after the construction phase and usually is not a continuing or long-term problem. However, studies of the effects of logging on stream environments have shown that it can take several years for stream sediment levels to return to pre-logging levels (Burns 1970, Moring 1975). Reduced production of salmonid fish could also be expected for 1 to 2 generations (usually 4 to 8 years) following adverse impacts from sediment.

The improper installation of culverts in roads crossing fish-bearing streams could obstruct spawning migrations of salmon or trout and prevent upstream dispersal of rearing salmonid juveniles (Dane 1978a).

In some areas, stream bank erosion or shifts in stream channel location could threaten the stability of transmission towers which are located adjacent to stream banks. This could necessitate bank protection measures such as those which were implemented on the existing 287 kV line in the Dasque Creek area (km 105S to 107S; Plate 5.1-1) and at the Lakelse River crossing (km 118; Plate 5.1-2). Tower protection may involve the encroachment of rip-rap, sheet piling or other structures on the stream channel, thereby altering the channel hydraulic regime and possibly affecting spawning beds for a distance upstream or downstream.

The foregoing concerns relating to the effects of sedimentation and encroachments on the stream environment would also apply to eulachon spawning areas in the Skeena River mainstem in the vicinity of km 47 to km 73.

An additional concern of a continuing nature is the need for vegetation control along the right-of-way and the possible use of herbicides potentially toxic to fish. Two herbicides, 2,4-D and picloram (Tordon), have been used for vegetation control on the existing 287 kV transmission line as well as on other lines in the province. Herbicides can enter watercourses through direct application to the water surface, in overland flow during periods of intense precipitation, or by leaching through the soil. However, herbicide residues are unlikely to occur in streams once a significant runoff event has occurred (Lorz et al. 1979). The probability of herbicide entering a watercourse, either directly or by leaching through the soil, is highest in valley bottom areas such as the Skeena

PLATE 5.1-1

Dasque Creek in the vicinity of the existing transmission line crossing. This stream is typical of the unstable, fast flowing streams along the proposed right-of-way from km 105S to km 112S.

PLATE 5.1-2

Bank protection measures at the Lakelse River transmission line crossing (km 118).

River mainstem, where stream channels are often closely spaced and the water table is relatively high.

Additional site-specific concerns are:

1. Leakage and accidental spills of fuel, oil and other chemicals into watercourses during construction.
2. Sewage pollution from construction camps.
3. The development of borrow pits for road fill material.

Application of the measures recommended in Section 5.1.4(c) can mitigate potential impacts to a considerable extent from such factors as soil erosion and herbicide application, and fish obstruction and stream channel alterations can be avoided.

(b) Sensitive Areas

The following areas along the proposed routes are especially sensitive to impact from the project. The reasons for sensitivity are explained below.

(i) Prudhomme Lake East Inlet

This stream is an important spawning area for sockeye, coho and chinook salmon, and cutthroat trout. The proposed route parallels the stream for its entire length, (km 10N to 14N) and construction of an access road will create the potential for significant siltation in this stream.

(ii) Lachmach River

The route parallels Lachmach River for its entire length (km 19N to 26.5N) and crosses it at km 23.7N. Lachmach River, which supports chum, pink and coho salmon and steelhead trout, is one of the more important salmonid streams in the study area. The principal concern here is the potential for obstruction and siltation of the Lachmach River and tributaries due to construction of roads to and along the right-of-way.

(iii) Skeena River Mainstem (km 93S to 101S)

In this segment the route crosses eight channels of the Skeena River and runs adjacent to six pink and chum salmon spawning areas. From km 95.5S to 101S the route also crosses a number of small channels which are potential rearing areas for salmon and trout. The proximity of the route to these spawning and rearing areas increases the likelihood of harmful siltation or inadvertent obstruction of stream channels.

(iv) Middle Creek

This stream, which the route crosses at km 106.7S, supports pink and chum salmon spawning near its confluence with the Skeena River. Given the instability of the stream channel in the lower reaches, particular attention must be given to placement of towers so as not to necessitate future stream channelization work which could have an adverse impact on downstream spawning areas.

(v) Lakelse River

The route crosses the Lakelse River at km 117.8, near salmon spawning areas. The placement of towers on either side of the river must be planned to avoid extensive bank protection work such as that needed to protect the west bank tower of the existing 287 kV transmission line.

(c) Recommended Mitigation Measures

Recommended measures to mitigate or avoid adverse impacts on anadromous salmon and trout are organized according to the various phases of transmission line construction and maintenance. These recommendations should be considered as general guidelines which govern planning and construction throughout the route. As stream conditions, terrain and seasonal scheduling requirements differ greatly from one route segment to another, federal and provincial fisheries agency representatives must be consulted before detailed construction plans are developed for each area.

These recommendations have been prepared with reference to the following publications:

1. Environmental Design for Northern Road Developments (Curran and Etter 1976).
2. Handbook for Ground Skidding and Road Building in the Kootenay Area (Forest Engineering Research Institute 1976).
3. Effects of Forest Harvesting Practices on Spawning Habitat of Stream Salmonids (Slaney et al. 1977).

Additional references concerning specific subject areas are cited in each section.

(i) Centreline Survey

Field studies for this report were not sufficiently detailed to ensure identification of every waterbody important to the fishery resource. As a result, the following actions are recommended during the centreline survey stage of the project.

1. Before the route is finalized, a survey should be conducted by a fishery biologist to identify all important salmonid watercourses which will be crossed or closely paralleled by the route. The survey should include documentation of fish presence and habitat potential for spawning and rearing as required to supplement existing information.
2. Mark or flag all salmonid streams and watercourses which will require special attention and impact mitigative measures during the design and construction phases.
3. Adjust the route where possible, to avoid small streams which are likely to be salmonid spawning or nursery areas, and to maintain a "leave strip" of vegetation between the

transmission line right-of-way where the route closely parallels a stream.

(ii) Access Roads

The following measures are recommended for planning, constructing and maintaining access roads.

1. Develop and implement a plan which limits the amount of road construction required. Where possible, one road should be used for logging, clearing, construction and maintenance.
2. In locating access roads, avoid extremely erodible soils and limit the area of cut-and-fill slopes on unstable materials.
3. Keep road grades as low as possible and contour to slopes or place on benches.
4. Install stream culverts (a) at adequate intervals with higher frequency in areas of erodible soils; (b) in gravel material with a rock or boulder apron at the outfall in order to minimize erosion; and (c) of sufficient size and with debris control devices to prevent blockage.
5. Inspect and clean out culvert entrances and drainage ditches regularly.
6. Revegetate highly erodible slopes with grass, using mulch and hydroseeding as necessary (see Wilford 1974 for review).

Roads which will not be required for right-of-way maintenance should be treated as follows:

1. Remove temporary culverts and install cross-drains or waterbars to restore original drainage patterns.
2. Contour all slopes to a stable configuration.
3. Seed road surface and slopes with grass and utilize other stabilizing techniques where appropriate. Small shrubs are also useful for stabilizing disturbed areas and discourage the reuse of old access roads.

(iii) Right-of-way Logging

Logging access roads should be constructed according to the guidelines in Section (ii). The following additional measures should be taken:

1. Locate landings away from natural watercourses and seepage networks, away from steep sidehills where excessive cuts and fills may be required and no closer than 40 m from any stream channel.
2. Restrict skidding of logs during spring melt and autumn freezing conditions.
3. Revegetate with grasses all skid trails situated on moderate to steep slopes or in highly erodible materials.

If the logging is carried out under B.C. Forest Service supervision, B.C. Hydro should make the foregoing recommendations available to that agency.

(iv) Right-of-way Clearing

Clearing of the right-of-way should be carried out in compliance with established guidelines and clearing standards currently used by B.C. Hydro. The more important aspects of these guidelines relating to aquatic environment protection are as follows.

1. Hand clear areas within 60 m of any watercourse or on slopes with highly erodible soils, so as to leave organic soil layers and minor vegetation intact (B.C. Hydro Standard "A").
2. Burn machine- or hand-cleared debris in relatively small, dispersed piles, located so that residual material will not be transported into a watercourse.
3. Seed with grasses in the early spring or fall any machine-cleared areas within a year of clearing.

(v) Stream Crossings

The crossing of salmonid streams should be conducted under the following restrictions:

1. Keep construction activities in salmonid streams and their tributaries to a minimum at all times.
2. Conduct no activity for construction or maintenance within the stream during the incubation period (from spawning to fry emergence), to prevent mortality from silting of spawning beds.
3. Where possible, confine stream crossings with construction equipment to sites where stream banks are relatively low and will not be damaged.
4. Repair any damage to stream banks with recognized bank protection measures such as rip-rap, gabions or other acceptable means.
5. Design and install culverts in salmonid streams in compliance with Department of Fisheries and Oceans guidelines (Dane 1978b), to ensure upstream fish passage and to minimize erosion and siltation. These guidelines include culvert elevation, slope, capacity, tailwater conditions and installation methods and construction timing.

The period acceptable for instream construction and maintenance activity will vary from area to area, as spawning timing differs between species and between streams to some degree. Input from the federal and provincial fishery agencies will be required to define the acceptable period or "window" for instream activity at each stream. The window would generally be from 1 June to 15 August for chinook, pink or chum salmon. If only the later-spawning coho salmon are involved the window should be extended, i.e. from 1 June to 1 October. In the case of steelhead and cutthroat trout, spring-spawning species with later fry emergence, instream activity should not commence until 15 July or 1 August and should terminate on a date compatible with protection of the associated salmon species.

Transmission towers in the vicinity of streams or on the Skeena River mainstem islands must be located so they would not be vulnerable to stream bank erosion or shifts in channel location over the long term. Measures required to protect towers from being undermined by erosion could result in changes to the channel regime and thus adversely affect adjacent salmonid spawning areas.

Construction of transmission towers within the channel of the Skeena River mainstem may have to be restricted in certain areas to the November-February period, to avoid potential interference with the spawning runs and juvenile downstream migrations of salmonids and eulachon.

(vi) Right-of-way Vegetation Control

Vegetation control involving herbicide application would be administered under the provincial Pesticide Control Act, with referral of B.C. Hydro applications to all concerned provincial and federal government agencies. A 10 m "pesticide-free" zone is normally maintained around all waterbodies. For aerial application of herbicide, an additional safety zone (pesticide buffer zone) of variable width (50 m minimum) is required at all waterbodies to prevent entry of pesticide or pesticide residues by drift, run-off or leachate into the pesticide-free zone. Either ground application of herbicide or hand-clearing of vegetation would be required in proximity to streams and lakes.

Soil disturbance during construction could encourage establishment of red alder, a fast-growing species which would inhibit the establishment of desirable ground cover. Alternatively, hand clearing (B.C. Hydro Standard "A" Clearing) would minimize soil disturbance and disruption of low-growing species such as forbs, grasses, salmonberry and salal (J. Henigman, pers. comm.). As recommended previously, hand clearing should be utilized in proximity to all watercourses to minimize soil disturbance and thereby reduce the frequency of requirement for vegetation control along the right-of-way.

(d) Criteria Used to Map Resource Sensitivity and Impact

Resource sensitivity was rated as "high" where salmonid spawning areas occur, whereas sensitivity was considered to be "moderate" where only salmonid rearing was known to occur within the study area. No "low" sensitivity ratings were assigned. This rating system was based on the fact that (1) spawning areas are more sensitive to impact from transmission line construction than are rearing areas; and (2) rearing is generally more widespread than spawning and is, therefore, likely to be proportionately less affected.

With respect to resource impact mapping, the ratings were developed by assigning impact rating points to areas in proximity to the proposed routes, i.e. within 1 km, as outlined in Section 5.1.4(e). The mapping code was as follows:

Impact Designation	Impact Rating Score
High	greater than 2
Moderate	2
Low	1
None	0

(e) Criteria Used to Assign Impact Ratings to Route Alternatives

One (1) impact rating point was assigned where one of the following conditions occurred in the vicinity of salmonid streams or Skeena River mainstem spawning and rearing areas:

1. the route would parallel a stream;
2. major new road access would be required;
3. transmission towers would encroach on a stream, or tower instability due to bank erosion or channel shifts was a possibility; and

4. standard construction practices would be used.

Helicopter construction received an impact rating of "0", as relatively little terrain disturbance would be involved.

A summary of impact ratings for alternative routes is presented in Table J-8.

The total impact rating for a particular route segment consisted of the sum of points assigned for conditions (1) to (4) above. Impact ratings for route segments ranged from 0 to 3.

The potential for impact on eulachon spawning areas in the lower Skeena River was also considered. Because specific areas of eulachon spawning have not been identified, this category of impact could not be incorporated in the impact rating scheme presented in 5.1.4 (d) and (e). There are insufficient data to enable comparison of the route alternatives with respect to potential impact on eulachon.

5.1.5 AGRICULTURE

(a) Methodology for Sensitivity Rating

Agricultural sensitivity was determined largely on the basis of CLI capability and ALR designation. Areas with present agricultural development received additional weight. Table 5.1-7 outlines criteria for ratings which are illustrated on Maps AG-3 to AG-7.

(b) Impact Assessment Methodology

Impact ratings for individual map units have generally been assessed as being equal to sensitivity ratings because little development is present in the study area and few mitigation measures are recommended. Segment impacts (Maps AG-3 to AG-7) were determined largely by the amount of potentially productive land crossed by each section of the proposed line with minor adjustments for land (largely islands) with poor access. Criteria for assessment of segments are given in Table 5.1-8.

(c) Potential Impacts

Numerous studies have been conducted in order to more accurately define the impacts of transmission lines on agricultural production. Most types of agriculture can be conducted under high voltage transmission lines. Land lost to production through construction of towers and access roads is often the most significant impact. Rigid towers generally cause more land loss than guyed towers (Cote, Duvieusart et Associes 1975). Towers are obstacles to equipment and require special attention for weed control which results in lost time to the farmer. Transmission towers also restrict the movement of automated irrigation systems and are particularly incompatible with pivot systems. A landowner may be required to use a system that is less than optimum because of this.

Impacts during the construction phase are greatest when the line must cross existing cultivated areas. Possible impacts include damage to crops and drainage ditches. Passage of vehicles may also cause problems with soil compaction and erosion and could disrupt irrigation. Construction vehicles may carry weed seeds from other areas and thus cause weed spread.

Approximately one third (40 km) of the proposed route would traverse ALR land of Classes 1 to 4 capability. This land is almost entirely undeveloped, and the existence of a transmission line would have little or no effect on its future resource use potential. Future development is expected to consist of small scale horticultural farms. These operations can be designed around the transmission line and the use of automated irrigation systems is not anticipated. The only area where impacts on present production would occur is at Shames where a market garden could be traversed. These impacts are described further in Section 5.2. Although impacts for that segment would be relatively

TABLE 5.1-7

CRITERIA FOR RATING AGRICULTURE SENSITIVITY AND AREA IMPACT

Sensitivity Rating	Areas Included
High	Classes 1 to 2 undeveloped and in ALR. Classes 1 to 4 developed and in ALR.
Moderate	Areas described above not in ALR. Classes 3 to 4 undeveloped. Other land in ALR.
Low	Classes 5 to 6.
Nil	Class 7.

TABLE 5.1-8

CRITERIA FOR AGRICULTURAL IMPACT RATINGS FOR SEGMENTS

Impact Rating	Criteria*[1]
High	Transmission line crosses significant*[2] parcels of high sensitivity land which are currently under production or may be within 10 years.
Moderate	Transmission line crosses significant parcels of remaining highly sensitive land or moderately sensitive land.
Low	Transmission line crosses small or isolated parcels of highly or moderately sensitive land, or significant areas of low sensitivity land.
Nil	Transmission line crosses land with no agricultural sensitivity.

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*1 These criteria assume non-mitigatable land losses at tower sites, periodic disruption over the construction period, and land/time losses due to coping with other problems incurred by the line.

*2 Approximately 5 km or 30 percent of the segment, whichever is less.

high and of concern to the operator, the overall impact of the transmission line on agriculture would be low.

Some beneficial impacts may occur through development of access roads and removal of forest cover but these are expected to be small because no significant new access to agricultural areas is likely to be provided, large tree stumps are generally not removed, and the area has limited value for grazing.

(d) Mitigation Recommendations

The mitigation measures suitable for an area depend on the type and extent of agriculture development and on the capability of potential agricultural lands.

In areas where there is or might be agricultural use, and other route alternatives are acceptable from environmental and engineering benefit-cost perspective, the best form of mitigation is avoidance. The Ministry of Agriculture, for safety reasons, has expressed opposition to transmission line routings through known agricultural areas, especially vegetable production areas. In these areas, farmers spend considerable time in the fields under the lines. Although no overt health effects have been documented, there is concern over electrical shocks from induction. Risks can be minimized by grounding fences, buildings, irrigation structures, etc. Written safety instructions such as the B.C. Hydro brochure Play it Safe should be given to local farmers. The brochure includes precautions which should be taken in various situations, including using water or refueling vehicles near the right-of-way.

Site-specific mitigation on developed agricultural land along the route will only be required if it is necessary to cross the developed land at Shames. In general, where transmission lines cross existing agricultural land, interference can be minimized by following farm field or natural boundaries. The line could be located close to the road but it may still be necessary to cross one field presently in hay production that has vegetable potential.

Establishment of tower sites in consultation with the landowner could reduce impacts. Where it is expected that the right-of-way will be used agriculturally, clearing, including stump removal, could compensate somewhat for construction impacts by enabling land along the right-of-way to be developed at reduced cost to the farmer.

There is little that can be done in the way of planning site-specific tower and route locations on undeveloped agricultural land that would mitigate future impacts in the study area. In general however, locating the new line immediately beside the existing line or next to other existing rights-of-way would reduce impacts.

5.1.6 FORESTRY

(a) Discussion of Impact Factors

(i) General

The assessment of impact caused by a transmission line to forestry must consider the loss of land base for timber fibre production and the loss of present growing stock. By far the most serious is the loss of the land base for timber growing purposes.

(ii) Loss of Growing Sites

The loss of growing sites reduces the total mean annual increment (MAI) for a given management unit. Since the Annual Allowable Cut (AAC) is based on the MAI and standing mature timber, the AAC must be reduced for any loss in the MAI if a sustained annual yield is to be maintained. For practical reasons the AAC may be only periodically adjusted but eventually any change to the MAI must be taken into account.

The forest economy of the province is reduced in proportion to this loss in AAC. This loss to the economy becomes more significant the nearer it approaches the community, company or individual affected.

This loss of incremental yield is proportional to the lost area of normal forest stocking but the yield loss also varies with the site quality. As a rule of thumb, good sites may produce almost three times and medium sites may produce nearly two times the yield of poor sites.

(iii) Loss of Growing Stock

If the merchantable timber is harvested, the negative impact of lost growing stock decreases rapidly with the age of the forest stand. At maturity this impact may be nil since this timber harvested may substitute for other cut areas required to maintain the AAC of the management unit.

All mature timber may not be removed owing to economic and physical constraints to logging within the narrow confines of a right-of-way.

As much mature timber as possible should be salvaged from a right-of-way to ease future shortfalls. High unit costs may make complete utilization impractical. Low ratios of volume to units of roading, especially associated with poor sites, low quality timber or areas of difficult access may result in excessive unit costs.

(b) Methodology for Sensitivity and Impact Ratings

The methodology and data used to determine sensitivity and impact are presented in Appendix F. The factors considered in determining the sensitivity of an area to forestry impacts were site quality, timber maturity, potential growing stock, species and accessibility. Points (0 to 30) were assigned to various areas in the study area based on professional judgement of these factors. The highest points (30) would be given to a forest area most sensitive to disturbance or removal from forest management, for example a good site with immature coniferous timber and easy accessibility. The lowest points (0) or (1) were assigned to areas of non-productive lands having no present or potential forest growth capacity, such as the Skeena River. Mitigation measures such as high towers, which decrease clearing width requirements and vegetation management costs, or route locations through poor growing sites are theoretically possible, but were not assumed. Thus, impact ratings for a given route are of the same magnitude as the sensitivity ratings.

The areas rated for sensitivity were grouped into three sensitivity/impact classes (Table 5.1-9) and were mapped accordingly (Maps FO-1 to FO-7). Impact ratings for each segment were assigned based on the relative proportions of each sensitivity class crossed by the proposed route. Professional judgement rather than a formula was used to determine ratings due to the complexity and interrelationships among the factors desribed in the preceding paragraph.

Timber volume losses and growing site areas removed from production were calculated (Table F-4). The values are actually underestimates because losses due to danger tree removal are not included. The total losses of good and medium growing sites would range from 320 to 450 ha depending on the route chosen.

5.1.7 MINING

(a) Introduction

Much of the proposed transmission line route is on the north side of the Skeena River and adjacent to Highway 16 and/or the Canadian National Railway line. Numerous rock quarries and gravel pits lie along the proposed route.

(b) Sensitivity Ratings

The sensitivity of these resources is dependent on their end use and on the availability of alternate resources (Maps GM-1 to GM-7 and Table 5.1-10). Old pits, quarries and mineral claims are identified as insensitive to transmission line development. Small pits and quarries, those needing re-evaluation, borrow areas and current mineral claims and showings have low sensitivity. Sites where rock, gravel and sand resources have been estimated have moderate sensitivity. Sites where less common road building materials are available have high sensitivity. The rationale for identifying mineral claims and showings as low sensitivity is that these claims and showings, with the exception of the limestone, have not been recognized as being exploitable at present. In the case of limestone, other quarries have replaced the A.E. Barr quarry as a source of limestone, so it is not being used. The Fir prospect of Terrace Calcium Products Ltd, which is 9.5 km east of Terrace, is currently under investigation as a source of limestone for the area (Hora 1978).

On these bases, the sensitivities of sites along the route have been identified (Maps GM-1 to GM-7). Twenty-six sites are insensitive, 37 sites have low sensitivity, nine sites have moderate sensitivity and five sites have high sensitivity.

TABLE 5.1-9

CRITERIA FOR FORESTRY SENSITIVITY/IMPACT RATINGS FOR AREAS

Sensitivity Rating	Sensitivity Points*[1]
High	21 to 30
Moderate	11 to 20
Low	2 to 10
Nil	0 to 1

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*[1] Factors influencing the number of points given to any particular area include site quality, timber maturity, potential growing stock, species and accessibility. Points were assigned on the basis of professional judgement.

TABLE 5.1-10

CRITERIA FOR MINING SENSITIVITY AND IMPACT RATINGS

Type of Site	Sensitivity Rating	Mitigation	Impact Rating
No existing road access	nil	None	beneficial
Active Mineral Claim	low	avoid	nil
Ministry of Transportation and Highways Sites			
- depleted pits	nil	None	nil
- active rock, borrow pits	low	Co-ordinate*1	low
- winter sand <10 000 m³	low	Co-ordinate*1	low
- winter sand >10 000 m³	mod	Co-ordinate*1	mod
- crush base	mod	Co-ordinate*1	low-mod
- select base	mod	Co-ordinate*1	low-mod
- active gravel pit	mod	Co-ordinate*1	low
- top quality aggregate	high	Co-ordinate*1	mod

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*1 Where the line crosses a site, co-ordinate activities with the Ministry of Transportation and Highways. Where a site is avoided, its impact is reduced to nil.

(c) Impact Ratings

The impact of the proposed SKeena-Rupert transmission line could be two-fold:

1. Adverse impact - inaccessibility of resources due to locating transmission towers over the resource or locating lines close to a resource where blasting is required. However, even where the proposed transmission line would cross a gravel or sand deposit or rock quarry, the impact may be low depending on the positioning of the towers and the sag of the line. Tower spacing is variable, but averages approximately 400 m.
2. Beneficial impact - improved conditions for mineral exploration in remote areas by providing access and exposing bedrock.

Detailed right-of-way planning, tower siting, and construction require close co-ordination with the Ministry of Transportation and Highways, especially at sites 17, 24 and 59 where sensitivities are moderate to high due to the nature of material being excavated. However, impacts can be mitigated to a low level at these sites.

On these bases, the impacts should be low at sites 5, 8, 9, 17, 20, 24, 25, 26, 27, 45, 47, 53, 55, 58 and 59 and nil at the remaining sites (Table E-4 and Maps GM-1 to GM-7). The current Green River North (17) sand pit is on the south side of the existing transmission line and the proposed transmission line is on the north side; the existing transmission line divides the Ministry of Transportation and Highways Crown reserve in half. Undefined, but small quantities of sand are required from this pit for use in skid control on the highway in winter. Considerable sand would still be available from this pit even with a new transmission line. Of the sites with low impact site 5 consists of a group of mineral claims, sites 8, 9, 20 and 25 contain rock which is common in the area, sites 26 and 27 are used as borrow areas which are also common, the use of the Ayton Island (24) gravel pit is unknown and sites 45, 47, 53, 55 and 58 need re-evaluation. Some of these sites needing re-evaluation could be elevated to a higher sensitivity; therefore the potential impact on these sites could increase with future studies by the Ministry of Transportation and Highways.

The numbers of sites with low impacts are listed in Table J-13 for each segment. The impact of each segment was assumed to be nil if there were no impacted sites and low if there were one or more low impact sites. In the three segments where the proposed line crosses a moderately or highly sensitive site, the impact was assumed to be able to be mitigated to a low level if close co-ordination with the Ministry of Highways was achieved. As noted above, the use of segments which would require new access roads would result in slightly beneficial impacts. No moderate or high segment impacts are expected.

The numbers of sites with low impacts were used to sum the alternative route impacts as shown in Table J-14. These were used to rank alternates in order of preference as shown in the last column of that table.

The right-of-way should be located in co-operation with the Ministry of Transportation and Highways and the CNR. This co-operation would result in the proposed transmission line causing little or no effect on Ministry operations. Towers should not be situated over a future pit. If the proposed transmission line is kept close to the highway there should be less effect on known geological resources.

5.1.8 HERITAGE RESOURCES

The overview inventory of study area heritage resources precludes determination of sensitivity or impact at this time. The generality of available data prevents evaluation of individual heritage site significance, which is an important determinant of sensitvity and impact.

Field work at the preliminary assessment level was conducted in the fall of 1982 to inventory heritage sites and to map site potential.

This work is discussed in a separate report by Provenance Research Inc. Detailed assessment studies will be undertaken after centreline survey.

Because of the active geomorphic processes and the dense vegetation the density of heritage sites should be low. However, this hypothesis requires further field study. Some sites may exist along the transmission route but it is usually possible to make minor changes to the route, tower location, or clearing standards to avoid impacts on those sites. This is likely to be the case on the Skeena-Rupert proposed line.

5.1.9 RECREATION AND CONSERVATION

(a) Introduction

The proposed transmission line would have short- and long-term effects on recreation. Short-term effects would be those associated with an influx of construction workers, movement of construction material and machinery, and the construction itself. Long-term impacts would be permanent alterations of the environment resulting from the project.

In light of the short construction period and the small construction work force, most disturbance to recreation activities during construction would be minor. With careful construction practices and avoidance of highly sensitive areas, this impact can be minimized. Long-term impacts would be mainly indirect results of lasting changes made to the natural or man-made environment, such as a new access road through a wildlife habitat or a transmission line through a park. However, adverse long-term effects can be reduced if mitigative measures are followed.

The purpose of this section is to delineate sensitive recreation areas, discuss possible adverse and beneficial impacts associated with areas which fall within the proposed routes, and recommend preventive or mitigation measures.

(b) Sensitivity Ratings

The inventory data collected on recreation (Section 4.2.4) is the basis of the sensitivity assessment. The two outstanding recreation features are the scenic landscape of the Skeena River valley and the excellent opportunities offered by the river system for fishing and other water-based recreation activities such as boating. While the sensitivity of the former feature is site-specific, the sensitivity of the latter feature is more a function of construction practices or methods. In general, construction activities that affect aquatic resources would indirectly affect the sport fishery. For this section, however, sensitivity ratings of angling only reflect possible short-term site-specific effects of construction activities such as noise, debris piling, and site preparation. Since these possible impacts are short-term and would constitute minor disturbances to angling, no known angling locations are rated higher than moderately sensitive. Notwithstanding this rating, the sensitivity of the sport fishery to the project for the river system as a whole is high. This activity is an important recreation pursuit, both in its own right and as an economic benefit to the local population.

Similarly, construction activities which affect wildlife would also indirectly affect the use of the resource. Construction activities, especially access roads, would open more areas for wildlife observation and hunting, and may improve certain habitats. However, the project will affect the distribution and abundance of certain animals by changing their habitats, exposing them to over-hunting, and interfering with their movement. These direct adverse impacts on wildlife would impair resource use. Thus, in assessing the sensitivity of this aspect of recreation use, protection of animals from over-hunting, vulnerability of species to disturbance, preservation of habitats and wilderness opportunities of certain areas are all considered as important assessment criteria.

Other criteria used in sensitivity ratings include park locations, UREP sites, ecological reserves, areas with high CLI recreation capability (e.g. Class 2), outstanding recreation features and present and potential uses of an area (Table 5.1-11).

In general, parks, ecological reserves, significant scenic features, areas of high capabilities and areas recognized for conservation are rated highly sensitive. These include the three provincial parks - Prudhomme Lake, Diana Lake, and Exchamsiks River, the Flood Plain Island Ecological Reserve near the mouth of Exchamsiks River, the Khtada River waterfall and the Gitnadoix River valley.

Moderately sensitive areas include wildlife habitats which are sensitive to over-use, proposed ecological reserves and areas which receive frequent use for angling, viewpoints, or boating.

Places which receive moderate use or which have moderate capability are generally classified as low sensitivity areas.

All sensitive areas are shown on Maps RC-1 to RC-7 and discussed in Section 5.2.

(c) Impact Ratings

Impact ratings are generally lower than sensitivity ratings because mitigation measures are assumed. However, unlike sensitivity ratings, there are seven classes of impact ratings; three levels (high, moderate and low) of negative impacts, no impact, and three levels of positive or beneficial impacts (Table 5.1-12).

Man-made changes which improve the recreation opportunities and potential of an area would be considered beneficial. The transmission project would have largely negative impacts on recreation in the area. One exception is the north side of the Taylor-Prudhomme Lake system. The line may open access to this area which is now inaccessible but has the potential for hiking, camping, angling, viewing and so on.

TABLE 5.1-11

CRITERIA FOR RECREATION AND CONSERVATION SENSITIVITY RATINGS

Sensitivity Rating	Criteria
High	Designated recreation sites such as parks, ecological reserves, significant recreation features or areas of high capability according to CLI classification.
Moderate	Significant wildlife habitat, popular fishing and boating sites, proposed ecological reserves.
Low	Areas classified as having moderate recreational capability or moderate recreational use.
Nil	No recreational resources are present.

Prudhomme Lake park on the south side of the lake is often overcrowded. As areas suitable for park development in the general vicinity of Prince Rupert are limited, any addition to or expansion of the existing park system to serve the increasing population of the community would be considered an asset to the area.

The Exchamsiks Ridge segment is given a high impact rating. The Ayton, Khyex, Kasiks, Mt. Jackman, Exstew, Khtada and Exchamsiks Crescent segments are given moderate impact ratings. With the exception of the Prudhomme segment (C) which is given a moderately beneficial rating, all other segments have either low or no impacts. Impacts are described by segment in Section 5.2 and ratings listed in Table J-15.

(d) Mitigation

Most of the potentially adverse impacts during construction can be mitigated by avoiding sensitive areas. Traffic increases, noise, material and waste piling, and so on cannot be eliminated entirely, but the impact resulting from such activities can be lessened. These disturbances should not take place in or near parks, designated recreation sites, conservation areas, wildlife habitats, and areas designated as highly or moderately sensitive in this report.

Siting the transmission line right-of-way or access roads through existing parks, significant scenic features and conservation sites should be avoided because the impact would be long-term and often irreversible.

Since most other long-term impacts would be indirect results of changes made to the natural systems by the project, mitigation measures recommended for aquatic, wildlife and visual resources would apply to recreation and conservation as well.

TABLE 5.1-12

CRITERIA FOR RECREATION AND CONSERVATION IMPACT RATINGS FOR AREAS*[1]

Area Impact Rating	Criteria
High	Highly sensitive areas in which activities or facilities would be permanently impaired.
Moderate	Highly sensitive areas in which mitigation measures would reduce the level of impairment.
Low	Areas of low or moderate sensitivity in which a transmission line would cause a slight impact.
Slightly Beneficial	Areas of moderate capability made accessible by the project.
Moderately Beneficial	Areas of high capability made accessible by the project.
Highly Beneficial	Areas of low recreation capability changed to high capability as a result of the project.

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*1 Segments are rated according to the highest impact within each segment.

5.1.10 VISUAL RESOURCES

(a) Methodology for Sensitivity Ratings

Attractiveness, exposure and absorptive capability are all determinants of the sensitivity of a landscape to alteration (Fig. 4.2-1). Criteria for sensitivity ratings are listed in Table 5.1-13.

(b) Sensitivity Analysis

Visual sensitivity is a measure of the potential for alteration of the visual resource from its existing state due to development or disturbance. Where the existing landscape is in a natural undisturbed state, potential for alteration is much higher than if the landscape already harbours such developments as transmission lines, pipelines, logging and so on. Maps VR-1 to VR-7 document the visual sensitivity of the study area.

The landscapes with the highest visual sensitivities are those whose landscape absorptive capabilities are low, but whose exposure and attractiveness values are high. Steep forested slopes visible from the main highway, parks, or farms are considered highly sensitive for these reasons. Open water in visual units of high attractiveness and in areas visible from the highway is also considered highly sensitive. Large portions of the Skeena River are in this category.

Moderately sensitive areas exhibit various combinations of the factors discussed previously and are widespread throughout the study area. The lowest sensitivity areas are usually relatively flat and not visible from roads or other viewpoints. Low attractiveness and highly absorptive discontinuous forest cover are also contributing factors, for example, in the Lakelse visual unit. Existing development such as a right-of-way is also often present as well, for example, in the Gitnadoix River and Dasque Creek areas.

TABLE 5.1-13

CRITERIA FOR VISUAL SENSITIVITY RATINGS

Sensitivity Rating	Criteria
High	Areas with both high attractiveness and high exposure
	Areas of low absorptive capability with either high attractiveness or high exposure.
Moderate	Areas not included above with at least two of the following characteristics: moderate or low absorptive capability, moderate or high attractiveness, moderate or high exposure.
Low	All remaining areas.

(c) Mitigation Recommendations

Because the visual attributes and recreational values of the study area are high it is important to lessen any potential impact that a proposed transmission line may have. The legal right-of-way for the transmission lines would be up to 109 m wide in areas where the existing 287 and proposed 500 kV lines are side by side and would appear as a cleared swath through otherwise dense coastal forest. Such a contrast is considered harsh, unnatural and disturbing in an otherwise natural vista. With the exception of the Kloiya, Rainbow and Tyee segments, the transmission line structures are unlikely to be placed against the skyline due to forest and mountain backgrounds. Thus it is the cleared right-of-way itself which will be most visible.

Transmission line crossings of the Skeena River are highly visible. At the present time the Skeena River between Terrace and Prince Rupert is crossed in three places by transmission lines; once by the existing 287 kV line at the Scotia River mouth; once near Terrace by the northbound 137 kV line; and one at a highly visible crossing near Tyee by the Falls River 60 kV line. The proposed 500 kV line would add five new river crossings, some of them highly visible from Highway 16. In addition, the possibility of placing towers in the mainstem of the Skeena River at Exchamsiks Provincial Park to circumvent a steep bluff would add an additional high visual impact from the river.

One of the best ways to avoid visual impacts is to locate the transmission line through low sensitivity areas, but it is impossible to do so in the Skeena-Rupert study area because of the extensive high and moderate sensitivity landscapes. It is also highly desirable to keep the proposed line adjacent to the existing line, but this is not always possible for security reasons.

The mitigative strategy in these sensitive landscapes should be to lessen the contrasts between the right-of-way and it surroundings and to reduce visibility of the right-of-way. The following practices, (Beak Consultants Limited and Associates 1979) most of which can be incorporated into the vegetation management program, are recommended for use in high and moderate sensitivity areas wherever appropriate. Where visual sensitivity is low, any necessary mitigation measures are specifically stated in Section 5.2.

1. Selective clearing to remove only tall-growing species will reduce the abruptness of right-of-way edges. This is feasible and is recommended in all areas where there is an existing shrub understory. A more natural forest opening is created by this practice which is sometimes called "feathering," because a forest proceeds from dense tree cover to thinned occasional cover to tall shrub to low shrub at the centreline.

2. Contouring right-of-way edges is recommended in areas where no natural shrub growth occurs because it lessens the straight-line scar effect. Undulating edges can blend in better with natural topographic patterns. Contouring has been successfully practiced by Bonneville Power Administration with continued reliability and cost-effectiveness (Marjerrison and Wilson n.d.).

3. Retaining and encouraging all low-growing vegetation species in the right-of-way will be aesthetically pleasing and also help inhibit growth of tall-growing species, reducing maintenance costs in the long run.

4. Retaining and managing buffer strips of vegetation on and/or adjacent to the right-of-way at road, railroad or water crossings where the transmission line is highly visible will reduce visual impact. Topping of trees instead of removal at high visibility crossings is also suggested.

5. Selective rather than broadcast applications of herbicides are recommended for aesthetic as well as vegetation management objectives. A number of utilities in the United States have adapted selective treatment strategies for visual, wildlife and maintenance reasons (Niering and Goodwin 1974).

6. Tall growing vegetation should always be retained where it does not interfere with conductors or structures, for example, in gullies, low areas along the centreline profile, or at bases of hills which are crossed by the line.

7. Planting screens of fast growing trees or shrubs between roads and rights-of-way where no screen or buffer strip presently exists. Sitka alder, mountain ash, conifers and willows would be appropriate.

8. Skyline backgrounds should be avoided wherever possible, and forest or hill backgrounds utilized instead.

9. New access or spur roads should conform to land contours and avoid steep grades which could lead to erosion problems. Ditching, culverts or other means should be used to maintain natural drainage patterns.

10. When more than one transmission line exists in a valley or visual unit, they should be routed adjacent to each other if possible. Not only is the total area of visibility reduced, but the visual impact is confined to a single part of the visual unit and does not necessarily dominate that unit.

11. When parallel lines are placed adjacent across a slope, the higher towers (i.e. the 500 kV tower) should be on the low side of the hill. In this way, clearing width and visual impact of the right-of-way on visually sensitive slopes is minimized.

12. Overhead crossings of large bodies of water should be avoided or minimized. Where unavoidable, crossings should be located and engineered to minimize the span and number of towers over water. One method of doing this is to locate the line at right angles to the river.

13. To minimize visual impact along a valley, transmission routes should be located on the same side and above the roadway or predominant viewing area. In this way, the valleyside that is constantly or more frequently in view would not be disturbed.

The above recommendations will hereafter be referred to as recommended mitigation measures for visual resources.

(d) Impact Assessment

The impacts discussed in Section 5.2 are those which are expected to occur despite mitigation or in places where mitigation is not possible. There are places where high exposure in combination with other factors will make the transmission line impossible to screen.

The criteria used to determine impact ratings are outlined in Table 5.1-14. In areas where mitigation is recommended but not carried out, the sensitivity ratings would apply rather than the impact ratings. Impact ratings by segment are listed in Table J-17 and for route alternatives in Table J-18.

5.1.11 LAND STATUS AND USE

(a) Introduction

This impact assessment identifies present and future land use concerns. Land status data, zoning designations and interviews with local government officials were the principal sources for the analysis. Sensitivity and impact ratings have been assigned in order to rate the magnitude of concern.

Leases and easements give the holder certain legally enforceable rights to land. Where Hydro interferes with these property rights or causes damage to them, compensation may be payable.

Reserves established under the Land Act are withdrawals of Crown Land made by the Crown to protect the land from alienation. They are used for special land management purposes. No person can acquire an interest in land through a Land Act reserve and therefore compensation would not be payable to any person other than the Crown if Hydro requires use of such land. However, if there is a loss of potentially valuable land use the cost of acquisition from the Crown may be high.

(b) Methodology

The literature on right-of-way land use assessment methods is limited. This methodology is based on a review of previous B.C. Hydro studies and consultation with a land use specialist (Thomas, pers. comm.).

First, sensitivity zones within the study corridor were identified and mapped according to the rating system outlined in Table 5.1-15. Sensitivity ratings represent the potential for damage from disturbance with no mitigation. Sensitive areas are illustrated on Maps LS-1 to LS-7.

TABLE 5.1-14

CRITERIA FOR DETERMINING VISUAL IMPACT RATINGS OF AREAS AND SEGMENTS

Impact Rating	Criteria
High	High sensitivity areas where even with mitigation, visibility remains high and high scenic values would be permanently impaired. Segments are given high ratings overall if 50 percent or more of the segment is subject to high impact.
Moderate	High sensitivity areas in which mitigation measures like screening, buffer strips and good vegetation management would reduce impacts to a moderate level. Also, areas where an existing transmission line makes the addition of a second one only a moderately disturbing change. Segments are given moderate ratings overall if 50 percent or more of their lengths are subject to moderate or high impacts and do not meet high impact criteria.
Low	Moderate sensitivity areas in which mitigation measures will reduce impacts or areas in which an additional transmission line will cause only a slight additional impact. Segments are given low ratings if they do not meet criteria for high or moderate impact.

The second step was to identify the residual impacts anticipated following mitigation (i.e. unavoidable effects on existing and potential land use as well as land status).

The major long-term impact that transmission line construction could have on land use is alienation or the interference of the right-of-way easement with future development. It would be preferable to route the transmission line parallel to existing rights-of-way or along property boundaries. The rating scale in Table 5.1-16 provides criteria by which the potential impacts on existing land use and future development were judged.

Mitigation and compensation recommendations are based on those suggested for gas pipelines (British Columbia Hydro and Power Authority 1980). In general, adverse impacts could be mitigated by proper construction techniques, effective site restoration and minor route changes.

Where compensation is necessary because of direct impacts and inability to carry out mitigation, property owners would be compensated for land, crops, trees and buildings directly affected by right-of-way acquisition, construction of the transmission line or access to it. The B.C. Hydro and Power Authority Act and the form of right-of-way agreement used provide for settlement in cases of disagreement. Compensation would also be considered where direct costs were incurred by existing municipal and regional authorities as a result of project related activities.

(c) Summary of Findings

The study area includes several areas that are sensitive from a land use planning perspective. However, proposed route locations and standard mitigative procedures should eliminate or substantially reduce most impacts. Tables J-19 and J-20 in Appendix J list impact ratings for each segment and route alternative.

TABLE 5.1-15

CRITERIA FOR LAND STATUS AND USE SENSITIVITY RATINGS

Rating	Criteria
High	Indian Reserves - Indian bands have indicated concern over transmission routes through reserves. In addition, reserve lands are held by the federal Crown in trust for Indian bands.
	Water licences and watersheds. Without adequate planning a transmission line can severely impair water supply sources. Poor footing locations can result in major short term and possibly long term impacts to water supply. The use of herbicides on rights-of-way must be restricted near water supply areas.
	Mineral springs. These are recognized as unique features by the provincial government and any form of development at them requires prior authorization.
	Crown grants, leases, easements and reserves smaller than 4 ha. Properties of this size would suffer loss of value and potential use.
	Moderately built-up area with probable future growth.
Moderate	All tenures not already considered above including Crown grants, leases, easements and reserves equal to or greater than 4 ha. All forms of tenure would be adversely impacted by a transmission line. The degree of sensitivity is considered moderate since the properties are larger than 4 ha and the transmission line would not seriously impair the future use. It could, however, reduce development potential and adversely affect property values (Kellough 1980).
	Potential settlement areas*[1]. There are several areas identified by local officials which have potential for future development. These include non-alienated lands only.
Low	Potential settlement area not identified by local officials. This is Skeena Station located between km 28S and 35. It is a flat area that could be developed with clearing and drainage. Since it was not identified by local officials and is somewhat remote it is rated low.

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*1 Potential settlement areas do not include lands that require extensive flood proofing or dyking.

TABLE 5.1-16

CRITERIA FOR LAND STATUS AND USE IMPACT RATINGS FOR AREAS*[1]

Rating	Criteria
High	An area identified as being highly sensitive to impacts with no opportunity for mitigation; Crown grants, leases, easements and reserves less than 4 ha which are traversed by the proposed transmission line.
Moderate	Crown-granted or Crown-leased lands larger than 4 ha with residential use which are traversed by the proposed transmission line. It is assumed that residential use on land holdings is more adversely affected by transmission routes than other land uses.
Low	All other tenures larger than 4 ha traversed by right-of-way. Crossing of any property would presumably result in some inconvenience or concern to tenure holders. Compensation rather than mitigation would be required in these cases. Crown reserves are included although no direct compensation is legally required.
No Impact	Water licences. Examination and mitigation on a site-specific basis should eliminate any potential impacts. Settlement areas. Where the proposed right-of-way parallels an existing corridor (e.g. highway, transmission line) or in some other fashion follows a rational route from a future land-use perspective the impacts are negligible. Other areas that are identified as sensitive within the study corridor, but are not actually traversed by the proposed transmission line.

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*1 Segments are rated as having high, moderate, or low impacts according to the highest impact in the segment.

Major land use issues are as follows:

1. Use of the Shames South segment would result in moderate land use impacts because two residential use properties would be traversed by the proposed transmission line. The Rainbow segment is given a high impact rating because of five small properties (three of which are residential) which the transmission line would cross. All other segments are given low or nil impact ratings.

2. A total of 27 private properties, five of which are residential, may be crossed by the proposed transmission line. Detailed assessment of the location of towers and line crossings will be required.

3. All water rights identified in Section 5.2 should be examined on a site-specific basis to ensure there will be no impacts or provide for compensation where necessary.

4. Potential settlement areas which may be affected by the proposed transmission line should not require further analysis unless the issue arises during the public consultation stage or if there are any changes in route in those areas.

5. Twenty-five of the 32 provincial Crown reserves which may be affected are quarrying and rights-of-way reserves held by the Ministry of Transportation and Highways. The status of these reserves is under review.

6. There are 19 Indian reserves in the study area (Table 4.3-1). Two (Khyex IR8 and Khtahda IR10) are traversed by the proposed transmission line.

A detailed description of potential impacts is in Section 5.2.

5.1.12 HUMAN ENVIRONMENT

(a) Introduction

The human environment component of the environmental route selection and impact assessment remains incomplete pending additional project information on the expansion of the Prince Rupert substation, discussions with local residents to determine their concerns about the proposed line, and a study of the impact of the proposed line on Indian bands in the area.

There are three potentially impacted population groups in the study area:

1. the Indian bands who own reserve land in the vicinity of the proposed route;
2. individual residents who live along the route, and;
3. the municipalities of Terrace to the east, and Prince Rupert and Port Edward to the west, located at each end of the route.

Apart from the potential impacts on Indian land use and disruption to residents living in the project area, the impacts of the proposed line are expected to be minimal for the following reasons:

1. the proposed line falls within an existing transmission corridor;
2. it passes between, but not through two regional centres;
3. the population within the corridor is sparse;
4. the proposed line is relatively short;
5. the size of the construction and operation work force is relatively small, and;
6. the construction period is short.

Detailed profiles have not been completed for any of the three groups potentially impacted because of the duration and scope of the anticipated impacts. Data have been compiled only on those factors relevant to the assessment.

The exact locations of access roads have not been determined to date, therefore they have not been addressed in this assessment.

The construction force required to expand the Prince Rupert substation will be defined in the near future. A socio-economic assessment of the expansion will be conducted when the information is available.

(b) Indian Bands

A study of the impact of the proposed line on Indian bands (Port Simpson, Metlakatla, Kitsumkalum) in the project area is in progress. These bands have a total of 19 reserves in the area of the transmission corridor. These reserves are unoccupied except for the Kitsumkalum IR 1 (which is outside the actual transmission corridor). Some of them, however, as well as adjacent land, may be important to the Indian people for subsistence activities. The study is therefore being undertaken to avoid possible land use conflicts. Discussions are being held with each of the bands to determine existing land use and to assess the potential impacts of the alternative routes on the bands. Concerns about the proposed line will be solicited during these discussions. DIA reports that the bands have concerns about the impact of the positioning of towers on islands in the Skeena River because of potential damage to the eulachon fishery.

Because the Indian study is still in progress, Human Environment impacts have not been rated and route preferences have not been indicated. Sensitivity ratings have been assigned according to the rating criteria in Table 5.1-17 (Table J-21). Sensitive areas have not been mapped specifically for Human Environment due to the on-going study, but the same sensitivities are reflected in the areas mapped for Land Status and Use (Maps LS-1 to LS-7).

(c) Residences Along the Route

Settlement along Highway 16 is sparse. Therefore the direct impact of noise or hazards resulting from increased traffic along Highway 16 during construction (assuming crew travel of 10 to 15 vehicles daily) is not expected to be significant, except perhaps to the family at Shames, if a route through Shames is utilized. The nuisance of traffic disruption and the impact on highway safety, resulting from the transportation of heavy equipment along the highway is unknown.

The family at Shames is concerned about potential interference by the route across their property with their radiophone and television reception. Another concern relates to potential electromagnetic effects from the line on humans and livestock. The literature on the biological effects of transmission lines does not generally substantiate this concern (Canadian Electrical Association 1979). However, alternate routing of the line would alleviate the potential stress caused by this perceived impact. A second family has an agricultural lease at Shames, hopes to settle there in the near future and is reportedly also opposed to the route through Shames.

Work camps along the right-of-way may be used if contractors find it economically feasible to house workers close to construction sites. A camp would house 30 to 40 people and could be required for up to three construction seasons. Kwinitsa and Salvus have been suggested as possible work camp sites. A highway maintenance crew is presently housed at Salvus, so this location is already recognized by local residents as a work camp site. Therefore an additional temporary crew should not present a problem. On the other hand, locating the camp at Kwinitsa could result in some disturbance to the resident family.

(d) Municipalities at Each End of the Line

As indicated, the size of a transmission line construction and maintenance work force is small and the construction period is short. Thus the project is not likely to affect the economic base, the population, or the lifestyle in the municipalities at the end of the route to any extent.

The total annual income for 1979 in Prince Rupert was $140,394,000 and in the Terrace district, $225,234,000 in 1980, making a total of approximately $365,628,000 for the study area. In 1982 dollars, this figure can be estimated to be in the range of $400 to $450 million. The project is expected to generate $32,557,000 (1982 dollars) in direct income to the project area over a 3-year period (approximately $11,000,000/year), of which $26,030,000 is for wages and salaries (not

TABLE 5.1-17

CRITERIA FOR HUMAN ENVIRONMENT SENSITIVITY RATINGS

Rating	Criteria
High	Indian reserves and land adjacent to reserves.
Moderate	Individual permanent residences along the route.
Low	Temporary work camps, highway maintenance camps, municipalities located at each end of the line.
Nil	No settlement.

all of which would be spent in the local area), and $6,527,000 for local purchases (Table 5.1-18). The change in local income (approximately 2 to 3 percent per annum) as a result of the project is therefore not a significant alteration in local income flow.

Survey and right-of-way logging for this project would take about 2 years (1983 to 1985). Clearing, foundation installation, tower erection and conductor installation are expected to commence in 1985 and last until 1988. Peak employment in 1987 would reach 250 persons (Table 5.1-19). Supervisory personnel constitute just over 10 percent of this figure on average, though less during the first half of the construction period. Of the non-supervisory labour force, approximately 60 percent are skilled, and the remainder, unskilled.

Hiring procedures will determine the extent to which local residents obtain employment in the project. Although there is no current contractual requirement on this class of project, construction activities normally employ union labour. Clearing is normally carried out by contractors with no union affiliation. Since the Prince Rupert-Terrace area has traditionally had strong union representation, and because the regional unemployment rate is high, the probability of local residents being hired on the project is increased. Project supervisory personnel would likely be hired from outside the area. Based on these assumptions, it can be concluded that in-migration during the construction period would be insignificant. Induced jobs in the sales and services sectors could easily be filled by local residents, considering the small number of jobs involved and the availability of workers in these categories. Thus, no in-migration is expected to be generated in these sectors.

Opportunities for temporary employment resulting from the project however, may be enough to maintain present levels of activity in the service sector or to tide local people over during this period of economic instability.

TABLE 5.1-18

INCOME GENERATION - SKEENA-RUPERT 500 kV TRANSMISSION LINE

The project is expected to generate a total of $32,557,000 in direct income (1982 $) to local communities. Approximately $6,527,000 is for local purchases including equipment rentals, construction materials, construction supplies, etc., while the remaining $26,030,000 is for wages and salaries.

A breakdown is as follows:

Year	Local Purchases	Wages/Salaries
1986	$2,854,000	$10,695,000
1987	2,854,000	10,695,000
1988	819,000	4,640,000
TOTAL	$6,527,000	$26,030,000

TABLE 5.1-19

DIRECT LABOUR FORCE REQUIREMENTS DURING CONSTRUCTION

Year	Peak Manpower (individuals)
1984	N/A
1985	50
1986	120
1987	250
1988	180

Source: B.C. Hydro, Transmission Projects Division, 1981.

Notes:

1. Logging would probably begin in 1984/85. Manpower estimates are not available as the contracts would be handled by the B.C. Ministry of Forests.
2. The manpower estimates include personnel for clearing, foundation preparation, tower erection and stringing.
3. The figures are based on 8 working months per year.

Because of the low employment impact anticipated, the related impacts on population size, community facilities and services are expected to be negligible.

Since the proposed project is near the municipalities of Prince Rupert and Terrace, the labour force may be housed in town, in which case transportation to the job site would be by ground vehicle.

Ample rental and commercial accommodation would be available in both regional centres to house any in-migrant work crew barring unforeseen changes in the economic situation of the area.

Existing crews and equipment in the North Coast Region would be utilized for the maintenance and operation of the transmission line. Thus, no additional work force would be required, and no additional income is expected to be generated.

Of the three incorporated communities in the area, only the village of Port Edward falls within the proposed transmission line corridor. The village recently extended its boundary to cover more area to the east, including land south of the existing highway, north of Inverness Passage and east of Tyee. Portions of the proposed alignment would be within the village's new boundary.

According to the policies adopted in the village's new community plan, future developments (residential, industrial, commercial, etc.) would be concentrated in the eastern and southeastern portions of the village, thus avoiding any direct conflicts with the proposed transmission line corridor. However, it is the objective of the village to ensure that any future developments both inside and adjacent to the village are reviewed by the village as well as government agencies, in order to ensure that the developments serve village interests (Village of Port Edward 1980).

SUB-SECTION 5.2 - SEGMENT IMPACT ASSESSMENT

This sub-section describes potential impact areas on a site-specific basis along each segment of the route. Mitigation recommendations assumed in the determination of residual impacts as well as the nature of the anticipated residual impacts are described. The impact ratings in the text and map volume are based on the criteria identified in Sub-section 5.1.

The ten sets of resource maps in the map volume identify all impact areas for each resource as high, moderate or low. Although some segment impacts for Recreation and Mining have been rated as beneficial (Appendix J), they are not mapped as such because the impacts are not site specific, but related to the general benefit of new access. A single set of multidisciplinary impact summary maps (IS-1 to IS-7) shows areas of high and moderate impact for all resources along the proposed routes. The impact summary maps are annotated with descriptions of the anticipated residual impacts.

In the case of Heritage Resources and Human Environment, the assessments are preliminary, pending results of ongoing studies, and impact ratings have not been assigned. The potential for the existence of heritage sites and human environment sensitivity ratings have been given instead.

If there are no outstanding inventory features, mitigation requirements or anticipated impacts for a resource in a given segment, the resource heading is omitted.

5.2.1 KLOIYA SEGMENT (A) km 0 to km 7.1

Vegetation

Sensitivity in this segment is high where the line crosses muskeg vegetation and low in coastal forest areas. Overall impact is expected to be high even if clearing and maintenance are selective and immediate steps are taken to restore original communities. The strategy of selective clearing, reclamation and selective maintenance described in Section 5.1.2 will henceforth be referred to as "vegetation management recommendations."

Wildlife

Construction of an access road from km 4.9 to km 7.1 would result in increased hunting pressure on deer. As the area affected is small and is already accessible by boat, the impact of a road here would be insignificant.

Aquatic Resources

At km 5.2 the route crosses the Kloiya River, an important spawning and rearing area for salmon and steelhead trout and one of the more important angling streams in the study area.

The potential for impact in this section is considered to be low, provided that the general mitigation guidelines are followed and that instream construction activity at the Kloiya River crossing is confined to the period 15 June to 1 August.

Forestry

Forestry impacts are low to moderate in this segment. There is fairly good accessibility. The area is a recreational reserve for Prince Rupert, thus no loss of inventory volumes have been calculated because the timber in this area is considered to be alienated from the Provincial inventory. Approximately 33 ha of productive forest sites would be cleared.

Mining

This segment crosses several active mineral claims which are mapped as site 5 on GM-1. The impact on these sites and this segment is considered to be low.

Heritage Resources

The segment has low elevation and gentle slopes, hence high potential for heritage sites.

Recreation and Conservation

The proposed route does not traverse recreation areas in this segment. However, there are two provincial parks adjacent to the route. Therefore, the Kloiya segment is rated as having a low impact on recreation.

Visual Resources

The route in this segment would be adjacent to the existing right-of-way. The route crosses areas of moderate visual sensitivity which are visible from Highway 16. All recommended mitigation measures should be implemented with special attention to screening the transmission line with buffer strips at road crossings, right-of-way feathering, roadside plantings, and retaining as much native shrub vegetation as possible. Overall impact is expected to be moderate even with landscape screening.

Land Status and Use

The proposed transmission line would cross five private tenures and one Crown reserve. It may reduce future development along this multi-use corridor. Potential impacts on land use and tenures would be low.

5.2.2 RAINBOW SEGMENT (B) km 7.2S to km 20.3S

Vegetation

Vegetation sensitivity in the Rainbow segment is moderate overall. Although the route cuts through low sensitivity coastal forest, it also crosses highly sensitive aquatic and muskeg areas and moderately sensitive alluvial forest. Overall impact would be low if vegetation management recommendations are followed. Where the right-of-way crosses roads, trees should be topped, not removed, to provide visual screening.

Wildlife

The only sensitive area in the Rainbow segment is the McNeil (Green) valley, which is moderately sensitive because of its moose habitat. Moose have been reported from km 18S to km 20S between the existing line and the highway. An access road along the proposed route would expose this small, concentrated population to heavy hunting pressure. Some other means of access, such as helicopters or temporary spur roads, should be used. To prevent disturbance to wintering moose, construction should be avoided in the McNeil valley from December through April. If these measures are followed, and the new line is located north of the existing line as planned, no impact is expected in this segment.

Aquatic Resources

In the Rainbow segment the route traverses Prudhomme Lake (km 7.3S to 8.4S) and passes within 0.5 km of Diana-Rainbow Lake at two points (km 12S and 14S). Diana Creek is a productive salmonid stream (Plate 5.2-1). The segment crosses the McNeil River (km 19S to 20S) in a tidal section downstream of salmon spawning and the principle rearing area. The potential for impact is low in this area provided that the general mitigation guidelines are followed.

Forestry

The Rainbow segment would receive low to moderate forestry impacts. The route crosses Timber Sale Harvesting Licence (TSHL) number A-01482 held by Boyle and Dean Logging. The proposed route parallels the existing route in many locations. Additional clearing in this and the Tyee segment would be less than that required in the Prudhomme-Lachmach alternatives. No good sites are traversed and only one small medium site is traversed. The standing timber volume on areas which would be cleared amounts to 4549 m^3.

Mining

This segment passes through or very near a rock quarry and sand pit (Sites 9 and 17 respectively). The line would have a low impact on mineral resources assuming good co-ordination with the Ministry of Highways.

Heritage Resources

The area between km 7.2S and km 9S is considered to have medium heritage site potential as is the area between km 18S and km 20.3S. All other areas are considered to be of low potential.

PLATE 5.2-1

Diana Creek, a productive salmonid stream flowing into Prudhomme Lake.

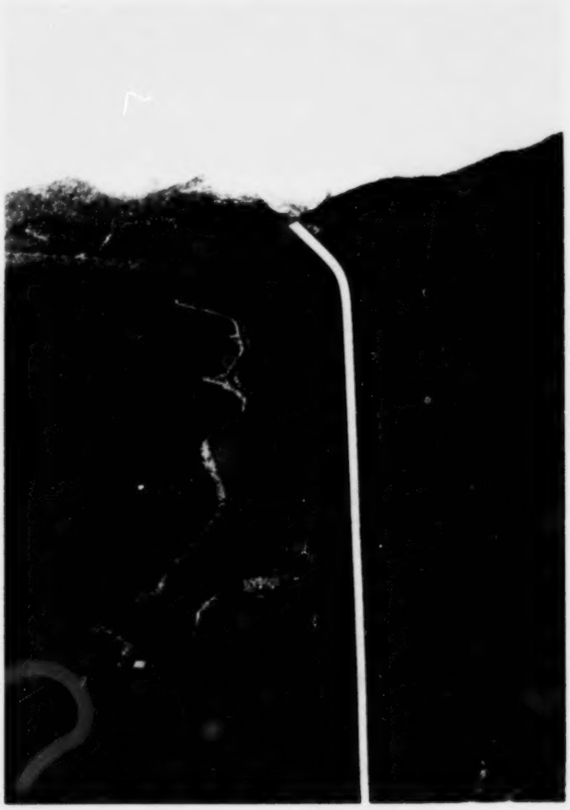

PLATE 5.2-2

In the Tyee segment the proposed transmission line would be above the highway and parallel to the existing 287 kV right-of-way.

Recreation and Conservation

The Rainbow segment passes over Prudhomme Lake, through the northern tip of the proposed Rainbow Lake ecological reserve and through a Class 3 CLI area at the mouth of the McNeil River. All are considered moderately sensitive. The general impact rating for the segment is low because neither the proposed reserve nor the river mouth appear to be heavily used for recreation.

Visual Resources

Visual sensitivity is mostly moderate. The line would be almost continuously visible along Highway 16. Screening, feathering, retention of shrub vegetation and other mitigation measures would be critical in keeping impacts to a minimum. Overall impact is expected to be moderate to low although high impacts may be expected on steep slopes near km 8.5S to km 9S and km 17S to 18S because terrain and vegetation types cannot satisfactorily screen the line. The new route would cross Prudhomme Lake adjacent to the existing line, so the overall change would be in the moderate to low range.

Land Status and Use

Impacts in the Rainbow segment would be high. The proposed line crosses five small private properties (three of which are residential) near km 11S. A potential settlement area between km 18S and km 22S is also crossed.

5.2.3 PRUDHOMME SEGMENT (C) km 7.2N to km 15.5N

Surficial Geology

The first 4 km (km 7N to km 11N) of the Prudhomme segment are on insensitive low elevation slopes mantled with a colluvial, morainic, or organic veneer. However, this segment would require new access road construction and could require the crossing of streams with important fish habitat or road construction on slopes drained by these streams. From km 11N to km 15N road construction and consequent alteration of slope stability and drainage patterns could cause erosion of the forest soils by mass wasting or fluvial processes. These impacts were observed along the gas pipeline route. Sensitivity and impact are rated low.

Vegetation

Significant muskeg areas would be crossed in the Prudhomme segment. If new permanent access is required the impact on vegetation would be high. Mitigative drainage measures discussed in Section 5.1 should be implemented and vegetation management recommendations followed.

Wildlife

Sensitivity and impact are low in the Prudhomme segment. Construction of an access road would increase hunting pressure over a large area. The deer population is dispersed and probably declining. Improved access is undesirable but would not be devastating, as utilization by hunters would probably be low. Use of a winter road, or other temporary road, should be considered. As the Lachmach valley is already accessible by road, no new access would be created by transmission line construction. If a permanent road is necessary the adverse impact could be minimized if it were not connected to the Lachmach road.

Aquatic Resources

From km 10N to km 14N the route parallels the inlet to the east end of Prudhomme Lake (Prudhomme Creek) which is a spawning area for sockeye, coho and chinook salmon, as well as cutthroat trout.

As there is no existing road access to the Prudhomme segment, the potential for erosion and consequent siltation of fish spawning and rearing area is relatively high, particularly where the route parallels a fish-bearing stream such as Prudhomme Creek. Along Prudhomme Creek a number of small tributaries, which are probably rearing areas for juvenile salmon and trout, drain across the proposed route.

Careful planning and construction of access roads (see general guidelines) would be required to minimize erosion and siltation impacts. Construction activity adjacent to streams must be restricted to the summer (June to 15 August) period to avoid impact on salmon eggs and fry. Overall segment impact would be moderate.

Forestry

Most of the forest lands in this segment are medium or low growing sites. The right-of-way would directly impact 50 ha of productive forest land. Much of the future logging will be done by helicopter because of the steep slopes. A transmission line along these segments would severely restrict forest harvesting because no insurance is available to contractors for log damage to conductors. The Ministry of Forests has expressed serious concern over this route. After km 9.8N the route crosses TSHL A-01482 held by Boyle and Dean Logging Ltd. Although only 562 m^3 of standing timber would be cleared from the right-of-way, forestry impacts in this segment would be high due to the need to restrict helicopter logging activities and to cross forest lands alienated from the Crown.

Mining

A transmission line and accompanying access road in this segment would be slightly beneficial for mineral exploration.

Heritage Resources

This segment and the Lachmach segment pass through only 5 km of terrain with high potential for heritage sites, so are preferred to the Rainbow-Tyee alternative.

Recreation and Conservation

The Prudhomme segment is presently inaccessible and has moderate to low recreation capability. No area is recreationally sensitive. From km 6 to km 10N, the segment follows the north side of Prudhomme Lake. The transmission line may open access to this area which has the potential to be developed for moderately active outdoor recreation such as hiking, camping, angling and aesthetic appreciation. With proper vegetation screening, the developed recreation area would not be affected by the transmission line in terms of visual impact. Thus, the transmission line would be considered to have a moderately beneficial impact on recreation for this segment.

Visual Resources

The Prudhomme segment has no access at present and is, therefore, not readily seen except near the recreational areas at Prudhomme Lake. Visual sensitivity is low to moderate except in areas of high slope and visibility. If a transmission line were built along the proposed route, an access road would also be built. The road is likely to be used for public recreation with Minerva Lake as the destination. Visual mitigative measures would be required, even in what are at present low sensitivity areas because of low visibility. Overall visual impacts are expected to be low.

Land Status and Use

The route in this segment is adjacent to the gas pipeline easement and several water licences at Prudhomme Lake. However, impacts are expected to be low.

5.2.4 CHANNEL SEGMENT (T) km 15.6N to 21.0N

Surficial Geology

This segment has sensitivity similar to the Prudhomme segment. From km 17N to km 20N road construction could cause erosion of the forest soils by mass wasting or fluvial processes. Sensitivity and impact are rated low.

Vegetation

Most of this segment crosses low sensitivity coastal forests. A small section between km 15.8N and km 16.9N traverses a highly sensitive bog-muskeg but the overall impact is rated low.

Wildlife

Sensitivity and impact are low in the Channel segment. In the western portion of the segment, as in the Prudhomme segment, deer would be affected if an access road is built. The head of Work Channel is used occasionally by swans, and there is a slight collision risk to swans flying between the channel and habitat in the Lachmach segment.

Aquatic Resources

In this segment, the route crosses a small, unnamed coho salmon and cutthroat trout steam (km 17.5N) which flows into Work Channel and parallels the Lachmach River from km 18.7N to 21.0N. Lachmach River is one of the more important salmon and steelhead trout streams in the study area. The general construction guidelines must be applied to mitigate impacts. The overall segment impact would be moderate.

Forestry

For the entire length of this segment, forestry impacts are rated as high due to the restriction of helicopter logging activities and the removal of 33 361 m³ of timber on 44 ha of good to low growing sites. The segment is entirely within TSHL A-01482 held by Boyle and Dean Logging. The Minerva segment would be preferable to this segment.

Mining

Slightly beneficial impacts are expected in this segment due to the anticipated requirement for new access.

Heritage Resources

The Channel segment is considered of high heritage site potential between km 17N and km 21.0N. All other areas are considered of low heritage site potential. Shoreline sites along Work Channel should be flagged so they can be avoided during construction.

Recreation and Conservation

The channel segment is too remote and inaccessible for extensive public recreational use. There is some fishing in the upper Lachman valley, however, this will not be affected by transmission line construction. Impact of the transmission line on recreation is nil.

Visual Resources

Visual sensitivity of this segment varies from high to low because of the attractive steep forested slopes that the route would traverse, and the visibility of the right-of-way from Work Channel. The impact of a transmission route on visual resources in this segment would be moderate.

Land Status and Use

The route parallels the gas pipeline easement. Impacts would be low.

Human Environment

Two Indian reserves, Lachmach (IR16) and Wudzimagon (IR61), owned by the Port Simpson Band, are located near the proposed route. Therefore, sensitivity in this segment is rated high.

5.2.5 MINERVA SEGMENT (U) km 15.6M to 19.5M

Vegetation

Although part of this segment crosses low sensitivity coastal forests, more than 30 percent of it crosses highly sensitive aquatic and adjoining bog-muskeg types, thus the overall impact is rated as high.

Wildlife

Deer populations in the Minerva segment would be affected if an access road is built. Regardless of whether the Minerva or the Channel segment is selected, it is important that any access road constructed in the Prudhomme valley not be connected to the existing Lachmach road.

Anticipated impact in the Minerva segment is low. The Minerva segment is slightly preferable to the Channel segment because it avoids an area of low collision hazard to swans.

Forestry

Impacts are rated as high for this segment, but they would not be as severe as for the Channel segment alternative. Slopes are not so steep as to warrant helicopter logging, and 29 ha of growing sites are medium to low with a standing timber volume of 16 852 m^3. This segment is wholly within TSHL A-01482.

Mining

Slightly beneficial impacts are anticipated in this segment due to the probable requirement for a new access road.

Heritage Resources

The entire Minerva segment is considered of medium potential for the presence of heritage resources.

Recreation and Conservation

The Minerva segment traverses areas presently inaccessible for recreation. Minerva Lake appears to be suitable for boating and fishing, however, the transmission line would not affect these activities. Impact of the transmission line on recreation would be low.

Visual Resources

The Minerva segment is a moderate to high visual impact area because of the steep forested slopes from km 17M to 19M. The transmission line would be most visible from Minerva Lake, as the highlands at the north end of the lake are an important aspect of the lake's scenic setting.

It is possible to mitigate this impact by re-routing the right-of-way to north of the knoll (as suggested by the Ministry of Forests), thereby putting it out of sight from Minerva Lake. If this re-routing is undertaken, the impact on visual resources would be moderate.

Human Environment

Two Indian reserves, Lachmach IR16 and Wudzimagon IR61, assigned to the Port Simpson Band are located near this segment. Therefore sensitivity is rated high.

5.2.6 TYEE SEGMENT (D) km 20.4S to 30.8S

Vegetation

Most of the vegetation in the Tyee segment is coastal forest with small areas of alluvial forest. Sensitivity and impact are expected to be low assuming vegetation management recommendations are followed. Spur roads or materials sites should not be located in the marsh area near km 28S.

Wildlife

The sensitive wildlife areas in the Tyee segment are along the tidal flats. The adjacent river and tidal flats are important to migrating and wintering waterfowl. Eagles concentrate here during the eulachon run in late March and early April. The proposed transmission line is not expected to affect waterfowl or eagles because it will be on the sidehill. No impacts are anticipated.

Aquatic Resources

The Tyee segment crosses three small, high-gradient streams, Stapledon Creek (km 22S), Aberdeen Creek (25S) and Antigonish Creek (29.2S), which are known to provide some rearing area for salmon, trout and Dolly Varden char juveniles in their lower reaches. The potential for impact on these streams and the segment overall is low, provided that the general mitigation guidelines with respect to access, construction and drainage control are followed.

Forestry

The Tyee segment would receive low to moderate forestry impacts. From km 20.4 to km 21.1S the route crosses TSHL A-01482 held by Boyle and Dean Logging. The proposed route parallels the existing transmission line in many locations. Additional clearing in this and the Rainbow segment would be less than that required in much of the Prudhomme-

Lachmach alternative. Although no good growing sites are traversed, 51 ha of medium to poor sites are crossed with a timber volume of 14 302 m³.

Mining

This segment passes through a rock quarry (Site 20), causing a low impact on mineral resources.

Heritage Resources

The Tyee segment passes close to three known pictographs at km 21S to 26S. Together, this segment and the Rainbow segment pass through 9 km of high potential heritage areas. Therefore, the Prudhomme-Lachmach alternatives are preferred.

Recreation and Conservation

The proposed route in the Tyee segment would cross over a CLI Class 3 recreation area at the mouth of the McNeil River. However, because the site is planned for industrial development and logging is underway upstream on the east bank of the river, the area was given a low sensitivity rating. Provided that the line is reasonably set back, good construction practices are ensured and habitat disturbance can be kept to a minimum, the segment would experience low impacts.

Visual Resources

Visual sensitivity along the proposed route in the Tyee segment is largely moderate except for low sensitivity flat areas near Inver and Antigonish creeks (km 28S to km 30S). The proposed line would not be highly visible from Highway 16 along this section as it would be above and beyond the view from the road (Plate 5.2-2). However, the broader right-of-way cut will be more visible to westbound highway traffic from 5 km upstream than the existing line is at present. The new transmission line would parallel the existing line for the entire distance hence the overall new impact is low. A small area on the mountainside near km 20.5S is given a moderate impact because it would be seen in closer proximity to Highway 16 than the rest of the line, which would be visible only from several kilometres away. Recommended mitigation measures should be carried out to ensure impacts are kept low.

The visual resource would be best preserved by routing the proposed transmission line through these segments and implementing mitigation measures to screen both new and old lines rather than by building a new line through the Prudhomme-Lachmach segments.

Land Status and Use

The route in the Tyee segment crosses one private property and a quarrying reserve. It passes through potential settlement areas at Tyee near km 30S. There is also a water licence maintained by CN downstream of the proposed route. The new transmission line would parallel the existing line, and with mitigation, impacts should be low.

5.2.7 LACHMACH SEGMENT (E) km 21.1N to 30.9N

Surficial Geology

In the Lachmach valley, there is a forestry road which can be used for access. Heavy equipment must be careful to avoid disturbance of the stream beds or cause siltation. The deep organics should also be avoided because of the disruption of ground water flow which would result. The organics are also an important engineering terrain hazard. In the middle of the Lachmach section (km 24N to km 26N) the route should avoid the northeast side of the valley which is subject to avalanching. Sensitivity and impact are rated low.

Vegetation

Although vegetation sensitivities range from low to high for the Lachmach segment which runs through coastal, successional and alluvial forests and muskeg, impacts would be low if vegetation management recommendations are followed. Preferably the line should follow the low slopes of coastal or successional forest rather than impinge on alluvial forest or muskeg, especially since the latter is highly sensitive.

Wildlife

Up to a dozen trumpeter swans use the lake and ponds in the Lachmach valley (km 23.5N to km 25N) as a migratory rest stop. The head of Work Channel is also used occasionally by swans. The risk of swans colliding with lines can be partially mitigated by locating the line well away from the lake and ponds, preferably in the forest. The collision hazard is not as great here as in some areas because of the small number of swans, the short period of use and the location of the line parallel to the flight path. Although sensitivity is moderate, impacts are anticipated as low.

Aquatic Resources

In the Lachmach segment, the route parallels Lachmach River (km 21.5N to km 26.5N) and crosses it at km 23.7N. From km 27N to km 29N the route is adjacent to Antigonish Creek. Lachmach River is one of the more important salmon and steelhead trout streams in the study area. Coho salmon spawning has been observed in the Lachmach near the proposed transmission line crossing. This stream is considered highly sensitive (Section 5.1.4(b)). The main concern is the potential for impact from construction of roads to and along the right-of-way, i.e. the possible obstruction and siltation of tributary rearing areas and the Lachmach River itself. The general construction guidelines relating to access roads must be applied to mitigate impacts. Overall segment impact would be moderate.

Forestry

Forty-two hectares of the forest lands in this segment are medium growing sites, and 12 ha are poor and low sites, with a total timber volume of 2005 m^3. Much of the future logging will be done by helicopter because of the steep slopes. A transmission line would severely restrict forest harvesting because no insurance is available to contractors for log damage to conductors. The Ministry of Forests has expressed serious concern over this alternative. The route crosses TSHL A-01482 held by Boyle and Dean Logging Ltd. Although most of the timber stands in the valley bottom have been logged, forestry impacts in this segment are high due to loss of medium growing sites and restrictions on future helicopter logging areas.

Recreation and Conservation

The Lachmach segment is already traversed by the gas pipeline and a logging road. Recreation potential is low due to restrictive topography and logging. Fishing takes place in the Lachmach River near the south end of Work Channel. However, this should not be affected by transmission line construction. Impact of the transmission line in terms of recreation would be negligible.

Visual Resources

The Lachmach segment has moderate visual sensitivity throughout its length and the proposed route is expected to have moderate to low impacts where it impinges on steep mountainsides. Despite the presence of a natural gas pipeline and logging in the valley, visual impacts would be greater in this segment than in the alternative Rainbow and Tyee segments since the 500 kV line would completely dominate the valley. Recommended mitigation measures must be implemented to keep impacts to a minimum.

Land Status and Use

In the Lachmach segment, the area between km 29N and km 31N is a potential settlement area. The proposed line is located at the toe of the slope so there should be no significant loss of potential settlement area. The pipeline route parallels the proposed line in the Antigonish valley. The impact would be low.

5.2.8 KHYEX SEGMENT (F) km 31.0 to km 35.8

Vegetation

Vegetation sensitivity is low throughout this segment (which is mostly coastal forest) except in the tidal marsh area west of the Khyex River at km 33. The tidal marsh should be spanned to avoid high impact from loss of valuable marsh communities with several rare species. If the marsh area is undisturbed by spur roads or tower sites, the overall impact in the segment would be low assuming vegetation management recommendations are followed.

Wildlife

Sensitivity in this segment is high. Anticipated impact is high at the Khyex River crossing.

The wetlands and tidal flats at the mouth of the Khyex form a valuable waterfowl habitat. The area is used by migrating waterfowl in spring and fall. Geese in flocks of 50 to 100 have been reported to winter at the mouth of the Khyex. A dozen or more trumpeter swans use the Khyex River and associated wetlands as a migratory stopover. The Khyex is in the area where eagles concentrate during the eulachon run.

The existing transmission line crosses the flight path between the main Skeena River and the Khyex wetlands and is a hazard to waterfowl. An additional transmission line will increase the hazard. The additional impact may be reduced slightly by locating the new line immediately adjacent to the old line.

No construction should take place from December through mid-May to avoid displacing waterfowl during periods when little habitat is available.

Aquatic Resources

In this segment the route crosses the Khyex River near its confluence with the Skeena River downstream of salmonid spawning and rearing areas. As the Khyex is a fish migration route at that point no adverse fishery resource impacts are anticipated.

Forestry

Forestry impacts would be low to moderate in this segment as 29 ha of the growing sites are low, poor or medium with Crown timber volumes of 13 630 m^3. Clearing may be difficult because of the hazard of the existing transmission line.

Heritage Resources

This segment is considered highly sensitive because it is at the confluence of two major rivers and there are reports of a historic cannery and Indian village on the flats to the west of the Khyex River.

Recreation and Conservation

The proposed route would cross over the Khyex River mouth, an important waterfowl habitat, where a recreation site and reserve are located. Although the new line would parallel the existing line, the potential disturbances caused by construction and widening of the right-of-way would be difficult to mitigate. Moderate impacts are anticipated in this segment.

Visual Resources

The Khyex segment has moderate to high visual sensitivity overall. With recommended mitigation measures, impacts are expected to be low except at the Khyex River, where views of the transmission lines would dominate the landscape (Plate 5.2-3). Buffer strips should be retained at the Khyex River crossing and between Highway 16 and the proposed transmission line.

Land Status and Use

The route crosses a right-of-way reserve. Discussion with Ministry of Highways may be required. The route also crosses Khyex IR8. The impact would be high unless the line is rerouted around the reserve. A rerouting may cause greater impacts on resource values such as visual resources and wildlife, so it is not a recommendation at this time.

Human Environment

The proposed route would cross the Khyex Indian Reserve IR8, which is jointly owned by the Metlakatla and Port Simpson bands. Thus, sensitivity in the Khyex segment is rated high.

5.2.9 AYTON SEGMENT (G) km 35.9S to km 47.3S

Vegetation

The Ayton segment is mainly coastal forest. It has low sensitivity over most of its length. The line does cross highly sensitive tidal communities on the Ayton Islands and on those islands construction would have a high impact. An area of moderately sensitive alluvial forest is also crossed near km 47S, but impact, as on the coastal forest, is expected to be low assuming vegetation management recommendations are followed.

PLATE 5.2-3

The mouth of the Khyex River. The transmission line would dominate the landscape here.

PLATE 5.2-4

The Kasiks River delta. The Skeena mainstem in this area contains pink salmon spawning grounds. The proposed transmission line would be highly visible from Highway 16.

Wildlife

The Ayton Islands are heavily used by ducks and geese during spring and fall migration. In February 1981, approximately 25 geese were flushed from the western island, indicating that the islands are used at least some winters.

Large numbers of eagles are present during the spring eulachon run.

A transmission line crossing in this area would create a collision hazard for waterfowl. There is probably more waterfowl movement downriver from the islands than upriver. Hence, the hazard could be reduced slightly by locating the towers at the eastern tips of the islands rather than in the middle.

Construction should be avoided on the islands during spring (15 March to 15 May) and during winter if waterfowl are present.

The ridge west of the Scotia River is inhabited by a herd of at least seven mountain goats. As their habitat does not extend across the proposed route, the major impact on these animals would be disturbance during construction. No construction requiring helicopters should occur adjacent to goat habitat (km 42.5S to km 45S) from December through 15 June and helicopters should stay away from the upper part of the ridge at all times.

Wildlife sensitivity is high overall, but impacts would be moderate if suggested mitigation measures are followed.

Aquatic Resources

The route crosses the Skeena (km 36S to km 41S) and the Scotia (km 46.8S) rivers in tidal sections downstream of salmonid spawning and rearing areas. No adverse fishery resource impacts are anticipated.

Construction work within the Skeena River channel may be restricted to the November to February period to avoid potential interference with the spawning runs and juvenile downstream migrations of salmonids and eulachon.

Agriculture

The Scotia River delta area is in the agricultural land reserve and is moderately sensitive. The segment overall is given a low impact rating because the difficult access hinders future development and the impacted area is small.

Forestry

Although this segment traverses 46 ha of poor growing sites, the forestry impacts are rated moderate. Between km 45.2S and 47.3S, the proposed line crosses TSHL A-03624 held by Q.C. Timber Ltd. Present inventory losses of 24 892 m^3 would be greater on this segment than the 17 760 m^3 losses on the alternative Telegraph segment, but long-term loss of mean annual increments would be lower. The Ayton crossing is therefore preferred from a forestry perspective. If this segment is used, the transmission line should avoid interference with the dry land sort area on the private blocks at the mouth of the Scotia River.

Heritage Resources

Impacts would be minimal along most of this segment, which is either rivercourse or mountainsides. However, heritage potential is high between Snag Point and the Scotia River (km 41.4S and km 47S). The alternate segment would avoid Scotia River.

Recreation and Conservation

This segment would cross the Skeena River over Ayton Island which is an important waterfowl brood rearing area: the sensitivity rating is moderate. The line would also cross the mouth of Scotia River. A logging camp is at the mouth and a logging road facilitates the logging operation. A transmission line would increase activity in the area, thereby increasing the opportunity for disturbance to the vulnerable goat population on the adjacent mountain ridge. This area is highly sensitive. A moderate impact rating is assigned, assuming recommended mitigation measures for wildlife and visual resources are followed.

Visual Resources

The Ayton segment is highly sensitive with respect to visual resources and is expected to have high impacts. Because the proposed line would cross the Skeena River at an obtuse angle, it is visible at close range for nearly 5 km of highway without the possibility of vegetation screening. From km 41S to km 45.5S the line traverses a highly visible steep slope which is uniform coniferous forest. Although feathering and retention of low shrubs are recommended, mitigation would not completely conceal the view of the right-of-way from the other side of the river. From km 45.5S to km 47S low impacts are anticipated if recommended mitigation measures are followed.

Land Status and Use

The route passes near a domestic use water licence at km 45.5S and crosses two properties, all of which are owned by B.C. Timber; it may interfere with existing land use and proposed development by the company. Impacts should be low, given the remoteness and unlikely industrial use of the properties.

Human Environment

An Indian reserve, Imkusiyan (IR65), is located in the area, so sensitivity in this segment is rated high.

5.2.10 TELEGRAPH SEGMENT (H) km 35.9N to km 47.2N

Surficial Geology

The proposed route in the Telegraph segment would parallel the existing line. It traverses the base of a steep bedrock slope covered with a colluvial veneer which is subject to avalanching and gullying. This segment has a moderate sensitivity rating. However, helicopter access for construction and maintenance has minimized the terrain impacts of the existing line; impacts could probably be mitigated completely or kept to a low level as shown on Map SG-3.

Vegetation

Impacts on vegetation are expected to be low. Most of the line crosses low sensitivity coastal forest except for a small area of alluvial forest near km 47N. In terms of vegetation this segment is preferred to the alternative river crossing over the Ayton Islands.

Wildlife

The Carnation Island area is of little importance to waterfowl. A second transmission line crossing the Skeena next to the first one would create a slight additional hazard to eagles and waterfowl. Impact would be low.

Aquatic Resources

The route crosses the Skeena (km 45N to km 47N) in tidal sections downstream of salmonid spawning and rearing areas and near the downstream limit of areas where eulachon spawning would be expected (D. Knapton, pers. comm.). No adverse fishery resource impacts are anticipated. Construction work within the Skeena River channel may be restricted to the November to February period to avoid potential interference with the spawning runs and juvenile downstream migrations of salmonids and eulachon.

Forestry

The Telegraph segment has 62 ha of medium and poor growing sites with an inventory of 17 760 m^3. Impacts are expected to be moderate. Long-term growth losses of 224 m^3/a would be greater for this segment than the 141 m^3/a for the Ayton segment.

Mining

There are four sites in this segment with a low impact rating, including one (site 24) with clean gravel, a relatively uncommon building material in this area. Assuming good co-ordination with the Ministry of Highways, the potential impact on this segment is judged to be low.

Heritage Resources

Potential along most of this segment is low because of the predominance of high mountain areas and riverine sections. However, the southern end of the crossing, near Scotia River, has high heritage potential. This segment is mildly preferred to the alternative.

Visual Resources

Although visual resources are highly sensitive on the steep slopes of this area, the existing transmission line traverses the lower slope, above the highway, lowering the sensitivity to a moderate level. A line adjacent to it would probably cause a low additional impact assuming that recommended mitigation measures were followed. The Skeena River crossing area is highly sensitive but the impact, if the line is placed adjacent to the old one, would be moderate, which is lower than if the proposed line crosses in a new location. Overall impacts would probably be low.

Land Status and Use

There is a quarrying lease near 44.5N, but no impact on it is anticipated. The route would cross the B.C. Timber property near 47N. Overall, low impacts are expected in this segment.

Human Environment

This segment crosses the river near Carnation Island, which may be utilized by the Indians for resource-related activities. Therefore sensitivity is rated high.

5.2.11 KHTADA SEGMENT (I) km 47.3 to km 65.5

Surficial Geology

This segment crosses 4 km of moderately sensitive hillslopes with thin colluvial veneer which are subject to avalanching and gullying. Impacts are expected to be low assuming helicopter access for construction and maintenance.

Vegetation

This segment includes predominantly low sensitivity vegetation types; coastal, black cottonwood and successional forests. Minor areas of alluvial forest and a small bog may also be traversed. Overall impact would be low assuming vegetation management recommendations are carried out. The small bog wetland near km 52 should be spanned.

Wildlife

Fifteen to thirty ducks were observed at Feak Creek on both helicopter flights in September 1980. This excellent waterfowl habitat is probably used in the spring as well. Construction should be avoided here during the spring migration period, 15 March to 15 May, if waterfowl are present.

The existing transmission line passes directly over this area. Construction of a second line adjacent to the existing one will increase the hazard to waterfowl.

During the eulachon run, eagle density is greatest between Telegraph Point (44.6N)and Kwinitsa. The proposed transmission line is located on a side hill in this segment and is not expected to affect eagles.

The eastern portion of this segment lies within the winter range of moose. From km 60 to the junction with Segments J and K, construction should be avoided during winter (December to April). This area is also potential calving habitat and appropriate constraints (Section 5.1.3(b)(i)) should be observed.

The possible construction campsite at Kwinitsa is located in mild winter range for moose. A camp at this location would result in habitat alienation, increased hunting pressure, and probably some disturbance to moose during winter. The impact of the camp would probably be low. This location is preferable to the one at Salvus.

At km 65.6 (the junction of Segments I, J and K), the proposed route passes through the only stand of mature coniferous timber on an island. Shifting the new line to the east side of the existing line is recommended to preserve the integrity of conifer cover for winter moose habitat.

Overall impacts on wildlife would be low if suggested mitigation measures are implemented.

Aquatic Resources

This segment crosses two salmonid streams, Khtada River and Feak Creek, downstream of salmonid spawning and rearing areas. The crossings of Skeena River channels between km 60 and km 65 could be in proximity to eulachon spawning areas. As noted for Segments G and H, seasonal restriction of construction work may be necessary to avoid impact on salmonid migration and eulachon spawning. No adverse fishery resource impacts are anticipated.

Agriculture

This segment has small and isolated areas of low to moderately sensitive agricultural land. Overall impact is rated low.

Forestry

Impacts to the forest resource are expected to be moderate: 91 ha of good, medium and poor sites supporting a Crown inventory of 259 793 m^3 are traversed. The proposed line parallels the existing line throughout most of the segment, so incremental losses are not as great as they would be if the rights-of-way were independent. Timber removal on the steep slopes from km 47.3 to km 49.0 and km 57.5 to km 60.2 may be hazardous to the existing line.

Heritage Resources

The Khtada segment has high heritage potential between km 53 and 56 and km 57.5 and 60.2, particularly in areas of creek mouths and stable terraces.

Recreation and Conservation

The proposed route would traverse a number of moderately sensitive fishing and wildlife viewing areas. These include the Khtada River mouth, and the Feak Creek delta, both of which are important waterfowl habitat, the Alder Creek slough, which is a moose habitat, and the tidal sand bars to the east of Selma Island, which are favoured angling locations. Recreational impact would be moderate.

Visual Resources

The visual resources of the Khtada segment have high sensitivity overall, although some flat areas are rated low and moderate. Overall impacts are rated moderate providing recommended mitigation measures are followed.

Land Status and Use

The route would cross the B.C. Timber property near km 47.3. The possible construction campsite at Kwinitsa is on vacant Crown land. The Khtahda Reserve (IR10) would be traversed, therefore the impact on land status would be high.

Human Environment

The Khtada segment would be close to IR11 and 11A (Scuttsap) and would cross IR10 (Khtahda). The Scuttsap Reserve is already traversed by the existing Skeena-Rupert line. This segment is rated high in sensitivity.

5.2.12 MT. BUCEY SEGMENT (J) km 65.6S to km 72.4S

Vegetation

Vegetation sensitivity in this segment is mostly low to moderate. The line crosses successional, black cottonwood and alluvial forest types. The small bog that is crossed near km 70S should be spanned. With vegetation management measures, the overall impact would be low.

Wildlife

As discussed above, the proposed route passes through a patch of mature conifer at the junction of Segments I-J-K. A route on the south side of the existing line, rather than the north side, would leave the patch intact, thus preserving moose winter habitat.

The mature timber at km 65.6S to km 67S and km 71.2S to km 71.6S provides winter range and potential calving habitat for moose. Construction should be avoided during winter and during the calving season.

From km 67.1S to km 70.2S, the line also passes through areas of mature timber. However, this coniferous cover is of limited value to moose in winter, because its location at the base of a north-facing slope subjects it to a deep snowpack.

Sensitivity and impact ratings are both low for this segment.

Aquatic Resources

Along this segment, salmonid spawning and/or nursery areas have been identified at Arga Creek (km 69.6S) and immediately upstream of the Skeena River crossing at km 72S. At the latter river crossing, care must be taken to ensure that the adjacent pink salmon spawning area is not affected by encroachment on the river for transmission tower placement or placement of material to protect towers from river bank erosion. Seasonal constraints on construction at watercourses, i.e. no construction from June to 15 August, should apply at the two spawning areas. Eulachon spawning may also take place in the Skeena River channels traversed in this segment. It may be necessary to restrict any construction work within the Skeena mainstem to the November to February period, to avoid potential interference with the spawning runs and juvenile downstream migrations of salmonids and eulachon. Provided these constraints are respected, impacts on fish would be low.

Agriculture

Most of this segment crosses wet, moderately sensitive Class 3 agricultural land. Overall impact for the segment would be moderate.

Forestry

This segment traverses 31 ha of good and medium growing sites. Impacts are likely to be moderate with 63 816 m^3 of timber affected. For the wet areas between km 70S and km 72S, logging may have to be done in the winter.

Heritage Resources

This segment has medium potential with respect to heritage resources. There is a slight preference for this segment over Kasiks segments because it avoids Kasiks/Skeena confluence.

Recreation and Conservation

This segment would follow the existing line which traverses moose habitat. The new line should not affect the recreation value of this area significantly as access to hunting would still be difficult. Thus, although sensitivity of the area is moderate, the potential impact, with mitigation, would be low.

Visual Resources

This segment generally has low visual sensitivity and low anticipated impacts. From km 69.5S to km 72.5S sensitivity is high due to the proposed river and highway crossings and the limited opportunity to screen the line. Buffer strips should be established where the proposed route crosses high sensitivity areas which support vegetation. This alternative is visually preferable to the Kasiks segment.

Human Environment

The proposed line would be close to Kasika (IR71), Kasika (IR72) and Salvus (IR26) Indian Reserves. Therefore sensitivity in this segment is rated high.

5.2.13 KASIKS SEGMENT (K) km 65.6N to km 72.5N

Vegetation

Sensitivities and anticipated impacts on vegetation would be low as the line traverses successional and black cottonwood forests. Vegetation management recommendations should be followed.

Wildlife

The islands crossed in the western portion of the segment (km 65.6N to km 68.4N) are wintering areas and possible calving areas for moose. Appropriate seasonal constraints on construction should be followed.

The flats at the mouth of the Kasiks River are important habitat for moose, waterfowl and furbearers. The entire river delta (km 69.3N to km 75.5) is a wintering area for moose, but most of the coniferous cover has already been removed. Devil's Island (km 69.3N to km 70.3N) is one of the few areas offering adequate cover - a dense layer of coniferous trees beneath an overstory of mature cottonwood. This small island, already fragmented by the highway and the railway, is heavily used by moose during winter. Reducing the cover by clearing will reduce the carrying capacity of the Kasiks flats for moose.

The Kasiks River delta, mouth, and associated wetlands are important waterfowl habitat. In February 1981 approximately 20 trumpeter swans were wintering in unfrozen sloughs at the western end of the Kasiks flats. Swans and geese have been reported in large numbers at the mouth of the Kasiks in spring. The presence of a transmission line over the Skeena near the mouth of the Kasiks, and along the highway east of km 70.3N would be hazardous to waterfowl, especially to swans.

The row of tall cottonwoods with mixed understory that borders the highway from km 70.3N to km 72.5N should remain intact. It offers visual cover and shelter to moose and other wildlife. If the transmission line were located immediately adjacent to this row of trees the risk of waterfowl collisions would be reduced slightly, as birds would gain altitude to avoid the trees and would be less likely to strike the conductors.

To protect wintering moose and migrating waterfowl from disturbance, no construction should take place from km 69.3N to km 72.5N from December through mid-May.

Because of the long-term impacts on waterfowl, especially swans and on moose winter range, wildlife impacts would be high. This route is undesirable from the standpoint of wildlife.

Aquatic Resources

This segment crosses Skeena mainstem channels near pink salmon spawning areas at km 67N and km 69N (Plate 5.2-4). Eulachon spawning may also occur in proximity to these channel crossing points. To avoid impacts to these spawning areas the measures proposed for the Mt. Bucey segment regarding tower placement and seasonal construction timing should also be applied here. With these measures, impacts are expected to be low.

Agriculture

Where this segment crosses the river islands, agricultural capability is Class 3 and sensitivity is moderate. Several kilometres of the route traverses the Class 2 flats east of the Kasiks River where sensitivity is high. The segment has high potential impact because agricultural development will likely occur.

Forestry

Forty-four hectares of the forest lands affected are good growing sites. Forestry impacts would be moderate with an inventory of 49 921 m^3 cleared. This segment has a higher proportion of good growing sites than the alternative, Mt. Bucey segment, hence is less desirable as route.

Mining

This segment crosses the edge of an aggregate site (45) that is now being used as a construction camp. There may be a low impact on mineral resources in this segment because the aggregate resource may be exploited in the future.

Heritage Resources

Devil's Island and areas west of the Kasiks River mouth have high potential for heritage sites. The Mt. Bucey segment is preferred.

Recreation and Conservation

This segment is well used for recreation. Activities include fishing, boating, canoeing, swimming, camping, picnicking and viewing. The Kasisks River delta, including Devil's Island, has moderate recreation capability (CLI Class 3) and has a UREP site. The delta is also an important wildlife habitat. The entire segment is rated moderately sensitive. Because the proposed transmission line would traverse the entire river delta, impact on recreation would be significant. A moderate impact rating is assigned for the segment. It is recommended that transmission towers not be located on the delta islands.

Visual Resources

The Kasiks segment includes a number of highly visible water crossings which are given high sensitivity and high impact ratings (Plate 5.2-4). Appropriate mitigation measures should be taken where vegetation is presently established. Approximately half of the segment's length would have low impacts if recommended mitigation measures are followed. From km 69.5N to km 72.2N it is essential that a screen of vegetation be retained between the road and the right-of-way. A strip of trees exists now, but should be enhanced by additional plantings. Overall impact would be high.

Land Status and Use

A forestry reserve at 72N would be crossed by this route. Impacts are expected to be low.

Human Environment

The proposed line would be close to Kasika (IRs71 and 72) and Salvus (IR26) Indian reserves. The Kasiks River mouth is a popular recreation and fishing area among Indians and local residents. The segment is rated high in terms of sensitivity.

5.2.14 SALVUS SEGMENT (L) km 72.6 to km 75.5

Vegetation

The Salvus segment is mostly successional vegetation. Sensitivity and impact ratings are low. Vegetation maintenance should include early treatment to suppress tall species even though little clearing may be required.

Wildlife

The Salvus segment, like the eastern portion of the Kasiks segment, is valuable habitat for moose, waterfowl (including swans) and furbearers. The impact of transmission line construction would not be as great as for the Kasiks segment. The wetlands are located mainly to the northwest of the proposed route and the area crossed by the transmission line is probably not a major flight path. The tall trees next to the highway west of Salvus should be left standing. East of Salvus, the habitat immediately adjacent to the highway is not much differentiated from that further away and does not offer good cover.

Because this general area is used by wintering moose, construction should be avoided from December through mid-April. Overall impact of the transmission line would be low.

The possible construction campsite at Salvus is located in severe winter range for moose. The nature of the impacts at Salvus would be the same as at Kwinitsa; habitat alienation, increased hunting pressure, and probably some disturbance to moose during winter. However, their severity would be greater here because of the greater importance of the Salvus flats as moose range. Anticipated impact of a construction camp at this location is moderate.

Agriculture

The Salvus segment crosses high capability (CLI Class 2) agricultural areas and is rated as a high impact area. Future agricultural development is expected.

Forestry

Overall impact in this segment would be moderate because 4 ha of good and 16 ha of medium growing sites are traversed. No Crown timber volumes would be affected.

Heritage Resources

This segment has a high potential for heritage sites.

Recreation and Conservation

The route passes through a wildlife viewing area and an UREP site. Both areas have moderate sensitivity. Segment impact would be low.

Visual Resources

This segment is characterized by moderate sensitivity but low impact provided that the route is located northwest of the existing buffer strip of trees. In addition, plantings would be required in areas where regeneration does not occur.

Land Status and Use

Private property at km 75 would be traversed. Impact would be low and compensation would be required. The pipeline easement intersects the proposed route. The proposed construction camp at km 74 is in a Forestry Reserve. Negotiation with the Ministry of Forests would be required in order to occupy the site.

Human Environment

Because of the highway yard at Salvus, the area is slightly sensitive (rated low). If careful construction practices are followed, the impact should be negligible.

5.2.15 EXCHAMSIKS CRESCENT SEGMENT (M) km 75.6S to km 77.3S

Surficial Geology

In general, the channel was judged to be not sensitive to a normal river crossing and was therefore mapped as nil sensitivity. However, the channel is sensitive to the type of construction required at this site.

Construction of the proposed line around the Exchamsiks Crescent requires that two or three sets of tower pads be built in a major channel at the confluence of the Skeena and Exchamsiks rivers. Disturbance of the channel bed and alteration of the sediment deposition pattern during construction and maintenance are the anticipated hydrologic impacts. Both sensitivity and impacts are rated low due to the requirement of in-channel structures.

Vegetation

In this segment the line crosses successional and alluvial forest types with low sensitivity. Overall impact is expected to be low if vegetation management recommendations are followed.

Aquatic Resources

The tower pads (two or three sets) which would be constructed in the main Skeena River at this point would encroach on the river and likely increase river velocities within a local area. The potential impact on the pink and chum salmon spawning area approximately 1 km downstream is considered to be moderate. No measures to avoid or mitigate such an impact are apparent.

Forestry

Forestry impacts would be minimal (rated low to nil), with less than a 2 ha loss of medium growing sites and no loss of present timber inventories in the segment.

Heritage Resources

The Exchamsiks River mouth and a known heritage site at the western edge of the segment have high heritage potential. If avoiding the site is a problem, the Exchamsiks Ridge segment is slightly preferred.

Recreation and Conservation

The highly visible powerline and towers would lower the aesthetic quality of the area, particularly for boaters and highway travellers. Because of the restrictive topography, little can be done to mitigate

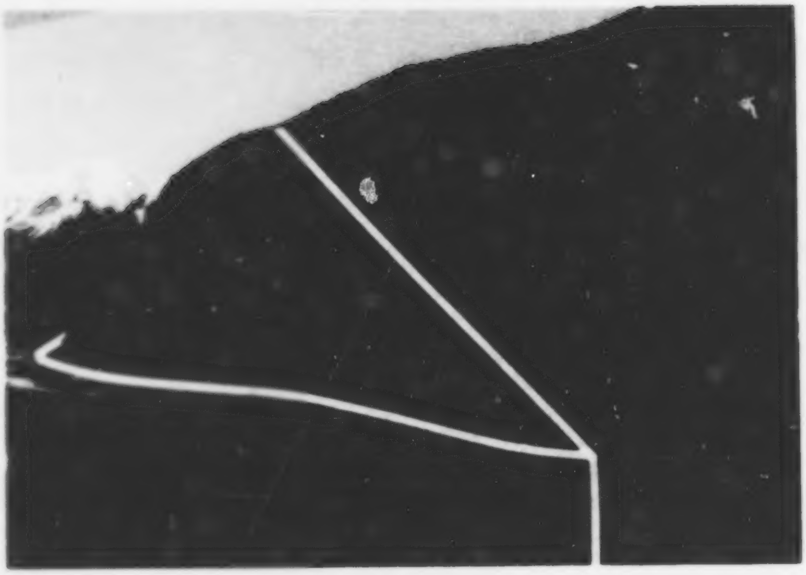

PLATE 5.2-5

Exchamsiks Bluff, showing two route possibilities. Either would result in a highly visible transmission line. The route shown over the bluff (Exchamsiks Ridge Segment) is approximate only.

the visual impact. A moderate impact rating is assigned since the towers and powerline would not directly interfere with any recreational activities.

Visual Resources

Because this segment is aligned between the highway and the Skeena River and no mitigation of visual impacts is possible, sensitivity and visual impact would be high (Plate 5.2-5). This alternative is somewhat preferred over the Exchamsiks Ridge segment because a right-of-way in the latter location will be visible for a longer distance.

Human Environment

On the opposite side of the Skeena River there is one Indian reserve owned by the Port Simpson Band. Therefore, this area is rated highly sensitive pending results of the Indian study. The existing line in this area traverses Gitandoiks IR75.

5.2.16 EXCHAMSIKS RIDGE SEGMENT (N) km 75.6N to km 77.0N

Surficial Geology

The extremely steep slopes of Exchamsiks Ridge segment are moderately sensitive to disturbance. The lower portion of the bedrock cliff facing the Exchamsiks River is subject to sheetwash during heavy rains and snow avalanches in winter. Clearing of the natural vegetation on the ridge crest would allow slope processes to initiate at the ridge top and follow down both sides of the ridge. Mitigative measures should include selective clearing of the ridge. The impact would remain moderate.

Vegetation

Vegetation on Exchamsiks Ridge is a combination of successional, coastal and alluvial forest. Although sensitivity ratings are low and moderate, overall impacts on the communities would be low assuming vegetation management recommendations are followed. Because of the steepness of the ridge, it is anticipated that trees would not need to be cleared from lower elevations adjacent to the slopes.

Wildlife

The steep mountainside on the east side of the Exchamsiks Ridge, north of the proposed route, is goat habitat. Because goats are disturbed by helicopters, construction requiring helicopters should be avoided from December through 15 June and helicopters should stay away from the ridge north of the proposed route at all times. With implementation of this measure, impacts would be low.

Agriculture

The segment traverses a very small area of Class 2 agricultural land. Impact on the segment would be low.

Forestry

Six hectares of poor growing sites and less than 2 ha of medium sites are traversed in this segment. Forestry impacts would be low to moderate. This segment is less preferred to the alternative, Exchamsiks Crescent.

Heritage Resources

This segment has high potential. A known site at the western edge of the segment could be avoided with careful routing. This segment is preferred over the Exchamsiks Crescent segment.

Recreation and Conservation

Construction may disturb park activities in the Class A Exchamsiks Provincial Park which is located within a CLI Class 2 (high capability) recreation area. The resident goat population may also be disturbed and transmission towers would ultimately detract from the scenic quality of the ridge. Hence the segment is highly sensitive and would have high impacts. The recreation impact would be higher than that of the Exchamsiks Crescent segment because this segment is valued more highly for its scenic quality.

Visual Resources

This segment has high visual sensitivity which can be mitigated only somewhat by the measures recommended in Section 5.1. Impact would be high since the right-of-way cut over Exchamsiks Ridge would be in the direct view of highway travellers for about 7 km from both directions, as well as from Exchamsiks River Provincial Park. If this alternative is chosen, mitigation measures should be taken but the impact would still be higher than on the Exchamsiks Crescent segment.

Land Status and Use

Negotiation with the Ministry of Highways would be required as a right-of-way reserve would be traversed.

Human Environment

On the opposite side of the river there is one Indian reserve owned by the Port Simpson Band. Therefore, this area is rated highly sensitive pending results of the Indian Study. The existing line in this area traverses Gitandoiks IR75.

5.2.17 MT. JACKMAN SEGMENT (O) km 77.1 to km 92.9

Surficial Geology

This segment includes moderately sensitive gullied and avalanching slopes on the north side of the Skeena River, and low sensitivity channel bars and islands within the valley bottom. Impact on the hillslope terrain is expected to be moderate.

Vegetation

Vegetation is mostly low in sensitivity. There are successional forests from km 78 to km 84 and black cottonwood forest from km 85.5 to km 93. Small areas of coastal forest and moderately sensitive alluvial forest are crossed. Overall impact would be low if vegetation management recommendations are followed.

Wildlife

The mouth of the Exchamsiks River is important winter range for moose. As the transmission line would be located immediately adjacent to the highway, little impact is expected. Winter construction should be avoided.

The flats east of the Exchamsiks River (km 79.5 to km 84), like those at the mouth of the Kasiks, are important for moose, migratory waterfowl, and furbearers. Swans have not been reported in these wetlands. The trees along the proposed route are too low to protect waterfowl from colliding with the lines. To protect wintering moose and migratory waterfowl from disturbance, construction should be avoided from December through mid-May. Mitigative recommendations for wetlands (Section 5.1.3(c)(iv)) should be followed.

Mountain goats are present on rock bluffs north of km 84. Assuming helicopters would not be used in this area, the goats would not be affected by construction.

The islands of the Hudson Bay flats (km 85.3 to km 92.2) are used by moose year-round. Except for a few small patches of conifer, they do not offer enough cover to shelter moose during severe winter conditions. Preservation of these patches is important, and the route has been adjusted to avoid a small conifer patch south of km 85. The islands are potentially important calving areas and appropriate constraints should be observed (Section 5.1.3).

Although sensitivity is variable in this segment, impacts should be low if the suggested mitigation measures are carried out.

Aquatic Resources

At km 77.5 the route crosses the Exchamsiks River near its confluence with the Skeena downstream of salmonid spawning and rearing areas. Between km 85 and km 93 the route crosses three Skeena mainstem channels which support pink and chum salmon spawning. The spawning areas are situated at km 85, 89, 90 and 92. As noted for the Mt. Bucey segment, transmission towers in the vicinity of spawning areas should be located so that no encroachment on the river is required. Any construction activity at these channel crossings should be confined to summer, i.e. June to 15 August, to avoid impact on salmon eggs and fry. Impacts are expected to be low.

Agriculture

The Mt. Jackman segment is rated as moderate for agricultural impact. It traverses Class 2 areas east of the Exchamsiks River and Class 3 areas for the remainder of the route. Immediate development is not anticipated despite the high capability.

Forestry

Moderate forestry impacts are anticipated because 70 ha of good to medium growing sites are crossed in this segment. A total of 78 182 m^3 of Crown timber would be affected. Timber licences belonging to B.C. Timber are crossed at km 85.3 to km 92.1.

Mining

The proposed route passes through sites 47 and 53 which have been identified by the Ministry of Highways as future sources of road-building material. Therefore, the impact on the segment has been identified as low.

Heritage Resources

One known heritage site is at the mouth of the Exchamsiks River. This area has high potential for further heritage sites. The remainder of the segment has medium potential for heritage resources.

Recreation and Conservation

This segment contains two sensitive areas. The Gitnadoix River mouth and the shore on the north bank of the Skeena River are both important moose and waterfowl habitats and are both sensitive areas because of their wildlife viewing capabilities. Impact is expected to be moderate.

Visual Resources

Visual sensitivity in this segment ranges from high to low as do potential impacts. Potentially high impact areas are the Exchamsiks River and highway crossings near Exchamsiks River Provincial Park. Recommended mitigation measures should be taken to reduce impacts near those crossings. Sensitivity remains high from km 79.2 to km 83.5, but if a screen of fast-growing trees could be established, impact would be moderate over the life of the transmission line. Cottonwood, alder or willow may be appropriate species. Km 84.9 to km 85.5 would be a high impact water crossing where little mitigation is possible. From km 85.8 to km 88.5 impacts would be low: mitigation measures such as retaining low-growing vegetation would be sufficient. Another water crossing from km 88.6 to km 89.2 would be highly visible and the impact would be high as well. The only mitigation possible would be vegetation screening of towers at crossing sites. Overall visual impact for this segment would be moderate.

Land Status and Use

The proposed route traverses an area of potential settlement, parallels the gas pipeline at km 86.5 to km 88 and parallels the highway between km 78 to 80 where the Ministry of Highways has a right-of-way reserve. Minor route relocation may be required. A low impact may occur.

Human Environment

On the opposite side of the Skeena River there are three Indian reserves (IR74, IR75, and IR76) owned by the Port Simpson Band. Therefore, the area is rated highly sensitive.

5.2.18 HUDSON SEGMENT (P) km 93.0S to km 100.8S

Vegetation

The overall impact on this segment would be low although a highly sensitive bog-muskeg vegetation type would be crossed between km 98S and km 99.2S. The impact on this area would be moderate if vegetation management recommendations are followed.

Wildlife

The island from km 94S to km 94.5S is a potential wintering and calving area for moose and would be subject to the same constraints as the islands of the Hudson Bay flats.

Between km 98S and km 99.5S, the route crosses wetlands which are surrounded by mature timber. Because of its position at the base of a north-facing slope, this timber is probably not used by moose in severe winter weather. The wetlands are used by swans during migration. The transmission line poses a collision hazard to swans moving between the wetlands and the river. The hazard has been reduced, but not eliminated, by adjusting the route slightly to the south. Mitigation measures for wetlands (Section 5.1.3(c)(iv)) should be observed.

As the collision hazard to swans has been partially mitigated, impact is rated as moderate.

Aquatic Resources

The proposed route crosses nine channels of the Skeena River between km 93S and km 101S. Pink and chum salmon spawning occurs adjacent to the route at six locations (near km 94S, 96S, 97S and 100S).

Any instream construction activity in Skeena mainstem channels and tributary streams along this route segment should be restricted to summer, i.e. June to 15 August, to avoid impacts on salmon eggs and fry. The overall segment impact would be moderate.

Agriculture

The Hudson segment traverses some isolated parcels of Class 3 agricultural land. Impacts on agriculture would be low.

Forestry

This segment crosses 35 ha of good and medium growing sites with an inventory volume of 10 777 m³. The overall impact is rated as moderate. At km 94S the line would cross some timber sales held by B.C. Timber Ltd.

Heritage Resources

This segment has high heritage resource potential in the area from km 98.5S to km 100S. The remainder of the segment has low to medium potential.

Recreation and Conservation

The route crosses a wildlife viewing area and good fishing may be found near this segment. However, the impact of the transmission line is expected to be low.

Visual Resources

High visual impacts would occur at crossings of the Skeena River from km 93.5S to 95.5S while impacts would be low in the forested valley bottom from km 96S to 101S. Overall impact would be moderate.

Land Status and Use

A small portion of the proposed line passes through a forestry reserve but impacts are expected to be low.

Human Environment

This segment crosses a number of islands in the Skeena River which may be utilized by Indian Bands for resource-related activities. Therefore sensitivity is rated high.

5.2.19 EXSTEW SEGMENT (Q) km 93.0N to 96.7N

Vegetation

Except for a small area of bog-muskeg at km 96.7N, the line would cross only low sensitivity vegetation types. Overall impact for this short segment is rated low.

Wildlife

The mouth of the Exstew River is a winter range for moose even though it has little coniferous cover. The wetlands near the mouth are used by furbearers and migratory waterfowl. Trumpeter swans winter around the mouth of the Exstew.

A transmission line crossing at the mouth of the Exstew would pose a collision hazard to swans and other waterfowl, as it would cross the flight route between the main river and the wetlands of the Exstew. The least hazardous location for such a crossing would be on the north side of the railroad bridge, where the line could be among trees as much as possible.

Impact on wildlife would be high in this segment.

Aquatic Resources

Pink and chum salmon spawning areas are adjacent to the proposed route at the mouth of the Exstew River (km 95.5N).

Instream construction work at Exstew River should be confined to the summer period, June to 15 August. With these mitigative measures, impact should be low.

Forestry

This segment crosses 35 ha of good and medium growing sites with an inventory volume of 10 777 m^3. The overall impact is rated as moderate. At km 94S the line would cross some timber sales held by B.C. Timber Ltd.

Heritage Resources

This segment has high heritage resource potential in the area from km 98.5S to km 100S. The remainder of the segment has low to medium potential.

Recreation and Conservation

The route crosses a wildlife viewing area and good fishing may be found near this segment. However, the impact of the transmission line is expected to be low.

Visual Resources

High visual impacts would occur at crossings of the Skeena River from km 93.5S to 95.5S while impacts would be low in the forested valley bottom from km 96S to 101S. Overall impact would be moderate.

Land Status and Use

A small portion of the proposed line passes through a forestry reserve but impacts are expected to be low.

Human Environment

This segment crosses a number of islands in the Skeena River which may be utilized by Indian Bands for resource-related activities. Therefore sensitivity is rated high.

5.2.19 EXSTEW SEGMENT (Q) km 93.0N to 96.7N

Vegetation

Except for a small area of bog-muskeg at km 96.7N, the line would cross only low sensitivity vegetation types. Overall impact for this short segment is rated low.

Wildlife

The mouth of the Exstew River is a winter range for moose even though it has little coniferous cover. The wetlands near the mouth are used by furbearers and migratory waterfowl. Trumpeter swans winter around the mouth of the Exstew.

A transmission line crossing at the mouth of the Exstew would pose a collision hazard to swans and other waterfowl, as it would cross the flight route between the main river and the wetlands of the Exstew. The least hazardous location for such a crossing would be on the north side of the railroad bridge, where the line could be among trees as much as possible.

Impact on wildlife would be high in this segment.

Aquatic Resources

Pink and chum salmon spawning areas are adjacent to the proposed route at the mouth of the Exstew River (km 95.5N).

Instream construction work at Exstew River should be confined to the summer period, June to 15 August. With these mitigative measures, impact should be low.

Agriculture

This segment traverses approximately 1 km of Class 2 land. Agricultural impacts would be moderate.

Forestry

The forestry impacts of this segment are rated moderate to low. Only 10 ha of good and medium growing sites would be affected. From km 93.5N to km 95.4N the route follows the southern boundary of TSHL A-01452 held by Price Skeena Forest Products Ltd.

Mining

This segment would pass through two sites that have been identified by the Ministry of Highways as future sources of road-building material. Therefore, the segment impact has been identified as low.

Heritage Resources

Between km 94.8 and km 95.5, the segment has medium potential for heritage resources: the remainder of the segment has low potential.

Recreation and Conservation

The transmission route crosses the mouth of the Exstew River, an area that is a wildlife viewing and fishing area. The route skirts the northern edge of the Exstew River UREP site. Impacts would be moderate in this segment.

Visual Resources

The Exstew segment has high visual sensitivity because the route follows the highway and crosses hillsides. With recommended mitigation measures some of these areas will receive only moderate impacts, but it would generally be a high impact area. The area from km 93.4N to km 95.7N would be highly impacted because of the road crossing, the steep visible hillside which the right-of-way would traverse, and the Exstew River crossing. Along the Exstew River flats (km 95.5N to km 97), impacts could be reduced to a moderate level with buffer strips of trees and tall shrubs.

Land Status and Use

The route crosses a forestry reserve. Impact would be low.

5.2.20 EXSTEW EAST SEGMENT (V) km 96.8N to 99.3N

Surficial Geology

This route would cross about 750 m of a hillslope which has a low sensitivity rating. Low impacts are expected.

Vegetation

For more than 30 percent of this segment, the route crosses a highly sensitive bog vegetation type, thus the overall impact would be high even though the rest of the route is through low sensitivity coastal forests. A slight shift of the route northward would avoid most of the bog and reduce the total impact to a low level.

Wildlife

This segment includes a portion of the flats at the mouth of the Exstew, which is important to moose, furbearers and waterfowl. Impact on wildlife would be moderate.

Agriculture

This segment crosses small parcels of Class 5 land. Impacts on agriculture would be low.

Forestry

In this short segment, forestry impacts would be mostly moderate. Good and medium forest growing sites would be crossed. Mature timber volumes of 38 337 m^3 would be affected.

Heritage Resources

The area between km 98N and 99.3N has high potential for heritage resources. The rest of the segment has low heritage potential.

Recreation and Conservation

There would be some low recreation impacts because of reduced wildlife viewing areas in the Exstew flats.

Visual Resources

Visual impacts would be moderate on the Exstew flats and high from 98.3N to 99.3N because of the slope, forest cover, and visibility of this latter area from several directions. Overall segment impact would be moderate.

5.2.21 CROSSING SEGMENT (S) km 96.8C to km 101.0C

This segment was not among those proposed in the Route Engineering Assessment report, but was examined by the environmental team as a possible way of avoiding impacts associated with segments Y or P.

Vegetation

The proposed line would cross low sensitivity black cottonwood and moderately sensitive alluvial conifer forests. With application of vegetation management recommendations impacts are expected to be low.

Wildlife

This segment crosses a channel of the Skeena at km 97.2C. Swans are known to use this channel about 2 km upstream, and to use the mouth of the Exstew River. Swan activity at the proposed crossing is unknown, but the possibility of a collision hazard exists.

The route crosses the edge of a mature conifer patch from km 98C to km 98.3C. If this area, which may be important as winter shelter, cannot be avoided, a moderate impact for the segment is anticipated.

Aquatic Resources

This segment passes within 0.5 km of a pink salmon spawning area in the Skeena mainstem. The probability of impact on fish resources is considered to be low.

Agriculture

This segment traverses small isolated islands of Class 3 agricultural land. Impact on this segment would be low.

Forestry

Overall forestry impacts in this segment would be moderate. Thirteen hectares of good cottonwood sites would be affected. However, few, if any, mature timber stands are present.

Mining

This segment crosses a site (58) which has been identified by the Ministry of Highways as a future source of road-building material. Therefore, the segment impact has been identified as low.

Heritage Resources

The most upstream portion of this segment (between km 100.5C and km 101C) has a medium potential for heritage resources. The remainder of the segment has low potential.

Recreation and Conservation

The transmission line would cross a fishing area in the Skeena River, however, no impact is expected.

Visual Resources

The transmission line would cross two channels in the river, each having a high impact on views from the highway and from the river. The crossing over the main channel would extend for 1.5 km as the route crosses the channel at an angle.

Human Environment

This segment crosses the islands in the Skeena River which may be utilized by Indian Bands for resource-related activities. Therefore sensitivity is rated high.

5.2.22 DASQUE SEGMENT (W) km 99.4N to km 106.0N

Surficial Geology

Stream mouth crossings in the Dasque segment pose hazards to the proposed transmission line. Fine grained marine and fluvial sediments are exposed in the cutbanks of several streams which the existing line and proposed route both cross. Increased siltation in the streams from the cleared right-of-way was observed during a September rainstorm. Mitigative measures include location of tower installations away from stream banks and maintenance of vegetative cover on the right-of-way. The sensitivity and impact ratings for this segment are low.

Although the fine sediments were not mapped on the preliminary B.C. Ministry of Environment terrain maps, they were observed during a field check by B.C. Hydro staff. Since the precise distribution of these sediments is not known, the areas of sensitivity and impact shown on Map SG-6 are subject to revision. Impacts would be highly site-specific, depending on local slopes, vegetation, and the location of surface channels. Potentially impacted sites on Map SG-6 are located where the transmission route intersects small channels as indicated on the route maps. Additional field work is recommended in order to define the location of impacts and environmental procedures for clearing and construction tender documents.

Vegetation

This segment crosses recently logged, successional and black cottonwood forest which are low sensitivity types. Alluvial forests also stretch for several kilometres along the proposed line. A highly sensitive bog may be crossed at km 111.8S. Although these areas may experience moderate impacts, the overall impact for the segment would be low assuming vegetation management measures are carried out.

Wildlife

From km 106S to km 112S, route passes the south side of a major wetlands complex. This area is used year-round by moose (though probably not in severe winter weather) and in spring and fall by migratory waterfowl. If the cleared right-of-way were located north of the existing access road, the visibility of the wetlands from the road would be augmented. The vulnerability of moose would be increased in this area where hunting pressure is already heavy. But if, as it appears, the new line would be located immediately adjacent to the existing line, (above the present access road), the impact would be minimized.

Construction should be avoided during winter in the Dasque flats area.

Overall impact would be nil or low, depending on precise location of the line.

Aquatic Resources

The proposed route crosses coho, salmon, and cutthroat trout rearing areas at Middle (km 106.8S) and Whitebottom (km 108.7S) creeks and crosses the former creek approximately 0.7 km upstream of pink and chum salmon spawning areas. Middle Creek was identified as highly sensitive to impact in Section 5.1.6(b).

Any instream construction activity in Skeena mainstem channels and tributary streams along this segment should be restricted to summer, i.e. June to 15 August, to avoid impacts on salmon eggs and fry. Careful attention must also be paid to the location of transmission towers in the vicinity of Skeena mainstem channels and in the Dasque Creek to Whitebottom Creek area (km 105S to km 109S) to avoid encroachment on stream channels and vulnerability to bank erosion or shifts in channel location. Such problems could necessitate periodic instream tower protection work which might adversely affect adjacent salmon spawning areas. Tower placement in the Skeena River off the mouth of Dasque Creek (106S) is indicated on the route map. If the footings for this tower are constructed during the winter low-water period, special precautions would be necessary to minimize the transport of sediment to salmon spawning areas downstream. Provided that the recommended mitigation measures are followed, the overall impact of construction in this segment is expected to be low.

Agriculture

This segment crosses a large section of Class 5 land east of Dasque Creek. Impacts on agriculture would be low.

Forestry

The proposed route generally follows the existing right-of-way, so incremental clearing would be less than for the alternatives north of the Skeena River. Forty-two hectares of the lands traversed are medium forest growing sites although 27 percent of the segment is nonproductive.

The route should parallel the existing right-of-way closely. Small "islands" of timber become subject to windthrow, fire and infestation. They are not as economical to manage or harvest. Less area is taken out of production than if two separate rights-of-way are utilized.

The segment crosses Tree Farm Licence No. 1 held by B.C. Timber at km 101S to km 103.8S and km 105S to km 113.5S.

Forestry impacts over the whole segment would be moderate.

Recreation and Conservation

This segment traverses some wildlife viewing area and some Class 3 CLI capability lands in the Middle Creek area. Recreation impacts overall would be low.

Visual Resources

High and moderate impacts would occur between km 101S and km 104S where the route would be highly visible from across the river. The remaining portion is in an area of low visibility and would require little mitigation. Overall, this route has low impacts and is preferable, from a visual standpoint, to the route alternatives on the north shore.

Land Status and Use

The proposed line parallels the gas pipeline from km 102S to 113S. Impact with respect to land status and use would be low.

Human Environment

The existing transmission line traverses an Indian reserve (IR85, Ksames) in the Dasque segment. The proposed line would be adjacent to it. Fishing camps are apparently located along the river banks during harvesting seasons. The reserves and adjacent areas are rated highly sensitive.

5.2.23 SHAMES NORTH SEGMENT (X) km 99.4 to km 106.0N

This segment was not among those proposed in the Route Engineering Assessment report, but was examined by the environmental team as a possible way of avoiding impacts associated with segments Y or P. It was subsequently determined that this segment was not environmentally desirable.

Surficial Geology

This route follows the northern edge of the Skeena River valley at the base of the mountainside and crosses several fan-shaped features composed of avalanche, debris torrent, and alluvial sediments.

Although slopes are moderate and surficial materials appear stable, the presence of engineering hazards suggest the likelihood of maintenance activity at intervals throughout the life of the project. Impact is rated low.

Vegetation

Less than 30 percent of this segment crosses moderately sensitive alluvial conifer forest, the remainder crosses low sensitivity coastal forest. Overall impact would be low.

Wildlife

The impact on this segment is difficult to evaluate, as it is not clear whether the right-of-way would be on the flats or on the sidehill. If the route were located on the flats, then mitigation measures for wetlands (Section 5.1.3(c)(iv)) might be required in some areas, and there could be a collision hazard to swans and waterfowl. A route located on the sidehill would have a lower impact.

In either case, a road located along the proposed route would significantly increase the accessibility and the visibility of the Shames flats and wetlands. Moose populations would be subjected to increased hunting pressure, and possibly harassment during winter. There is also a possibility of increased hunting pressure and harassment of goats on the ridge above the Shames flats from about km 102N to km 106N. Impact on wildlife in this segment would be moderate to high, depending on the precise location of the route.

Agriculture

If the proposed route crosses the lower mountainside as shown in Map AG-6 no agricultural land would be impacted. If it traverses the flats, significant areas of undeveloped Class 3 agricultural land would be traversed and impacts would be low to moderate.

Forestry

Fifty-three hectares of the areas traversed by the proposed line are classified as medium and poor forest sites. The impacts are expected to be moderate, with a timber inventory of 143 720 m^3 affected.

Heritage Resources

This segment has high heritage potential between km 99.4N and km 102N and low potential in the remainder of the segment.

Recreation and Conservation

This segment skirts a wildlife viewing area, however, the impacts on this activity would be low.

Visual Resources

The Shames north route would follow the base of the steep south-facing hillside. The towers and right-of-way would generally not be seen from the highway. The overall impact of a route in this segment would be moderate.

Land Status and Use

The proposed route crosses four private and one Crown lease property, all greater than 4 ha. The line would follow the northern edge of the properties resulting in a low impact on future land use.

5.2.24 SHAMES SOUTH SEGMENT (Y) km 99.4M to km 105.0M

Vegetation

Moderately sensitive alluvial conifer forest and low sensitivity coastal forest, black cottonwood and successional communities would be crossed in this segment. Use of existing access and application of vegetation management measures would result in a low impact throughout this segment.

Wildlife

The Shames flats (km 99.4M to km 106M) are important habitat for waterfowl, furbearers and wintering moose. Swans winter around the mouth of Esker Creek (km 99.4M). In February 1981, 18 swans were seen in a channel of the Skeena at about km 98.8M. When most areas are frozen, swans are reported to winter in open water between the old and new highways at the mouth of Esker Creek. The Shames slough, north of the proposed route, is used by migratory birds in spring and fall.

A transmission line crossing at Esker Creek would be hazardous to waterfowl, especially swans. If this route is selected, the line should cross the creek on the north side of the old road, to avoid crossing the flight line between the main river and the open water between the roads. There is some hazard to birds the entire length of the Shames flats.

Construction should be avoided in this entire segment from December through 15 May, to protect wintering moose and migratory birds. Mitigation recommendations for wetlands (Section 5.1.3(c)(iv)) should be followed.

Impact, like sensitivity, would be high in this segment.

Aquatic Resources

Chum and coho salmon spawning areas are adjacent to the proposed route at Esker slough. Instream construction work should be confined to June to 15 August. With these mitigative measures, impact should be low.

Agriculture

The Shames South segment, if chosen over the other alternatives, would have a high agricultural impact relative to other areas within the study area. Five km of high capability agricultural land would be traversed. Some of the land is producing marketable vegetables and the operation will be expanding.

Agricultural impacts that would occur are land loss to towers, operator time loss, soil compaction and crop loss during construction. The market gardener at Shames reports that compaction can restrict vegetable production for approximately 3 years. Of the estimated total of 600 ha of land best suited to agricultural development at Shames approximately 0.4 ha would be lost to production due to the presence of towers. It is unlikely that more than one tower would be required on land which is presently cultivated. In 1982 this land was in hay production.

For agricultural purposes, the transmission line would have lower impacts if it follows one of the other route alternatives. The Ministry of Agriculture and the market gardener have expressed their opposition to the Shames South route. If it is chosen, the line should be placed as close to the highway as possible. Impacts could be mitigated somewhat by allowing the landowner to do his own clearing to specifications that include stump removal.

Forestry

The areas traversed by the proposed line (42 ha) are classified as good, medium and poor forest sites. The impacts are expected to be moderate, although no Crown timber would be affected.

Mining

This segment passes through Site 59 (Map GM-6), a highly sensitive source of top quality paving aggregate. Impact on this segment is expected to be low assuming that right-of-way and tower locations are closely co-ordinated with the Ministry of Highways.

Heritage Resources

With the exception of the immediate areas around km 99.4S and km 105, the segment has low heritage potential.

Visual Resources

Buffer strips may have to be established on both sides of the line from km 100M to km 106N because viewing takes place from the highway and the farming areas. Because of expansion of the farming area, however, it is questionable whether an added agricultural impact due to loss of land for the buffer strips would be preferable to the visual impact. At this time, a buffer strip on the highway side of the line is the only one recommended. If the Shames South segment is chosen, the placement of the right-of-way and buffer strips should be discussed with the farmer concerned. Overall the impact on this segment would be high.

Land Status and Use

Six properties would be traversed by the proposed route. Two are residential properties larger than 4 ha. A moderate impact rating was assigned to this segment.

Human Environment

Considerable opposition to the route through Shames has been expressed by the farmer and his family who reside in the area. The family spent several years searching for the idyllic farming location in northern B.C. and fear that their lifestyle and livelihood would be affected by the line. The family sell vegetables off the farm and have plans to develop the property to supply a larger portion of the local market.

The family is concerned about electro-magnetic effects of transmission lines, both on cattle and humans, and about potential interference with telephone and radiophone reception.

Another family with an agricultural lease in the area plans to locate there after clearing some of the property, and are reportedly opposed to the Shames South segment as well. A moderate sensitivity rating has been assigned to this segment.

5.2.25 KLAKELSE CROSSING SEGMENT (Z) km 106.1N to km 112.7N

Surficial Geology

This segment includes about a kilometre of moderately sensitive marine silts. Impacts are expected to be moderate.

Vegetation

With the exception of two short sections of moderately sensitive pine forest between km 108N and km 109.1N, the line would only cross low sensitivity vegetation types. Overall impact is rated low.

Aquatic Resources

Pink and chum salmon spawning areas are downstream of the proposed route at the Shames River crossing. The Shames River is a steep, relatively unstable stream. Proper tower placement is important to avoid bank instability and shifts in channel location. Instream construction should be confined to June to 15 August. With these mitigative measures, impact should be low.

Agriculture

This segment crosses small isolated parcels of Class 2, 3 and 5 land. Impacts on agriculture would be low.

Forestry

The proposed line crosses 36 ha of good, medium and poor growing sites which support 6562 m^3 of Crown timber. The overall impacts are expected to be moderate. In two places the line crosses TSHL A-01452 held by Price Skeena Forest Products Ltd.

Heritage Resources

A high potential for heritage resources exists between km 106.1N and km 109.5N and again between km 111.8N and km 112.7N. However, the middle section (river crossing) of the segment is considered of low potential.

Visual Resources

The high impact areas in this segment would be the western side of the mountain ridge near km 106N and the mountainside, road and river crossings from km 108.5N to km 111N. Mitigation measures such as shrub retention and feathering would be appropriate for hillsides. Buffer strips at road and river crossings could be produced by topping of existing trees and maintaining shrub growth. All recommended mitigation measures should be considered for use on these and other high and moderate sensitivity sites.

Overall visual impact for this segment would be moderate and the route alternatives on the south side of the Skeena River are preferred.

Land Status and Use

The proposed route crosses the northern section of three private properties. Impacts would be low.

Human Environment

The proposed crossing of the Skeena River and its islands would be adjacent to the Klakelse Indian Reserve (IR86) which is jointly owned by the Port Simpson and Metlakatla bands. Therefore, sensitivity in this area is rated high.

5.2.26 LAKELSE SEGMENT (R) km 113.6 to km 126

Surficial Geology

The fine-grained marine silts and clays of the Terrace area are highly susceptible to erosional processes such as gullying, sheetwash and slumping when the vegetative cover is disturbed. Increased suspended sediment loading in several streams and the Lakelse River would probably occur during the construction phase. Limited use of access roads, selective clearing without grading, avoidance of steep slopes and stream crossings, and good vegetation maintenance to stabilize the surface should all be practiced. The sensitivity and impact ratings for this segment are moderate.

The terrain in the Lakelse valley bottom is mapped as having a low sensitivity but, as noted under "Aquatic Resources", bank erosion on the Lakelse River is a sensitivity that requires fisheries-related mitigation. The impact in this segment is mapped as moderate where the route crosses the easily eroded marine silts and clays on slopes and near surface channels. It is assumed that impact could be mitigated to a low level in the remainder of this terrain unit.

Vegetation

Almost all of this segment is successional forest although there are minor areas of coastal and black cottonwood forests. Impacts would be low and vegetation management should aim to suppress tall species growth on the right-of-way at the time of construction. Little clearing would be required.

Wildlife

This segment has value for wintering moose, migrating waterfowl and furbearers. Trumpeter swans have been reported around Lakelse Lake and probably use the Lakelse valley as a flight route. The area has been affected by logging, an access road, and existing transmission lines. The presence of an additional transmission line is likely to cause a low additional impact.

Aquatic Resources

The route crosses the Lakelse River (km 117.8) which is a major producer of all salmonid species. It also parallels the upper reaches of Alwyn Creek (km 123 to km 125), a small coho salmon stream. In Section 5.1.6(b) the Lakelse River was identified as highly sensitive to impact.

Problems have been experienced with protection of a tower on the existing transmission line on the west bank of the Lakelse River. River bank erosion in the vicinity has necessitated considerable bank protection work. As stressed for the Skeena mainstem, tower location must be carefully planned to avoid such problems with the proposed new transmission line. Any instream activity at Lakelse River must be restricted to the summer (June to 15 August) period. Impact to aquatic resources would be low in this segment.

Agriculture

Approximately half of this segment crosses low to moderate agricultural capability (Class 4 or 5) areas. The overall agricultural impact would be low.

Forestry

Fifty-two hectares of growing sites are classified as medium and poor. Most have been recently logged and are in various stages of regeneration, although there is a residual Crown mature volume of 9339 m^3. Between km 113.6 and km 115.5 the route is within Tree Farm Licence No. 1. The impact on the forest resource in this segment would be moderate.

Heritage Resources

The Lakelse River crossing is highly sensitive. Between the Lakelse and Skeena rivers, some ancient sites are possible, though unlikely. This part of the segment is moderately sensitive.

Recreation and Conservation

This portion of the Skeena valley is one of the most important recreation areas for the local residents. The Lakelse River is a favoured river for angling, particularly at its mouth, and the Skeena River is used for boating and canoeing. These activities, however, would not be disturbed, as the proposed route is set back from the mainstem of Skeena and the Lakelse River mouth where most activities concentrate. Overall impact would be low.

Visual Resources

Sensitivity ranges from low to moderate in the Lakelse segment. The proposed route follows the existing transmission line, there is active logging in the area, and the lines are not visible from Highway 16. Impact throughout the segment is expected to be low provided that recommended mitigation measures are followed. The most important areas for mitigation are the hillsides from km 113.5 to km 117 and km 119.2 to km 121.5, as well as the Lakelse River crossing at km 117.8. Because of exposure to view and recreational use, these areas should be appropriately maintained in low growing vegetation and screened.

Land Status and Use

Three properties are crossed in this segment. The proposed transmission line parallels the existing line and gas pipeline. Impacts would be low.

SELECTION OF ENVIRONMENTALLY PREFERRED ROUTE

SECTION 6.0 - SELECTION OF ENVIRONMENTALLY PREFERRED ROUTE

6.1 METHODOLOGY

As described in Section 5.0, resources along the proposed transmission route were evaluated in terms of the residual impacts of transmission development. Each segment and route alternative were given impact ratings for each resource by the team member responsible for study and evaluation of that resource. The criteria on which the ratings were based were developed in Section 5.1. Route alternatives were also ranked in order of preference for each resource. Detailed tables of impact ratings and preference rankings are in Appendix J.

With the impact assessments for each resource complete, the project team met to determine which route alternatives were preferred overall. For each of the five locations where there were alternatives, transmission line impacts on all resources were discussed and a consensus reached on the preferred alternative.

Section 6.2 summarizes the discussion of the project team during the meeting in which the preferred route alternatives were selected. The tables accompanying the text are summarized from those in Appendix J and were used as the basis of the discussion on route alternatives. No weight was placed definitively on one resource over another, but it became obvious in the team discussions that impacts to aquatic resources, wildlife and visual resources were considered the most serious. Studies in both heritage resources and human environment are continuing: preference rankings for heritage are considered tentative, and were not given for human environment.

6.2 ROUTE ALTERNATIVES

All areas given moderate or high environmental impact ratings are shown on Maps IS-1 to IS-7.

(a) Prudhomme (C) - Channel (T) - Lachmach (E) vs Prudhomme (C) - Minerva (U) - Lachmach (E) vs Rainbow (B) - Tyee (D)

Table 6-1 shows the impact ratings given by each resource specialist to these route alternatives. Mining and recreation would receive slightly beneficial impacts if a transmission line were located on either of the Prudhomme-Lachmach alternatives. These benefits would accrue because of projected use of an accompanying access road by local recreationists and exploration geologists. The Prudhomme-Lachmach routes are also preferred from the heritage resources standpoint because fewer high potential heritage areas would be traversed.

Forestry, aquatic resources, surficial geology, vegetation, wildlife and visual resources would all be adversely affected with the choice of either of the Prudhomme-Lachmach alternatives. The highest impact rating was assigned to forestry. Large volumes of timber maturing after the transmission line is built would be left unharvested because helicopter logging on the steep valley slopes above the transmission line would not be possible.

Important spawning and rearing areas near the Kloiya River, Prudhomme Creek and the Lachmach River would be subject to siltation, causing moderate impacts in the Prudhomme-Lachmach alternatives. Steep slopes and organic soils are two sensitive terrain types which would be crossed in these alternatives, causing subsequent impacts on surficial geology such as erosion and drainage interference. Bog areas lost because of access roads would result in higher vegetation impacts for this alternative than for the Rainbow-Tyee alternative. Slightly greater impacts are also expected to wildlife and visual resources. It is recommended that if the Minerva segment is used, it be relocated

TABLE 6-1

PRUDHOMME-CHANNEL-LACHMACH vs PRUDHOMME-MINERVA-LACHMACH vs RAINBOW-TYEE COMPARISON OF ALTERNATIVES

	Prudhomme (C) - Channel (T) - Lachmach (E)		Prudhomme (C) - Minerva (U) - Lachmach (E)		Rainbow (B) - Tyee (D)	
Resource	Impact Rating	PR*	Impact Rating	PR*	Impact Rating	PR*
Surficial Geology	low	3	low	2	nil	1
Vegetation	moderate	2	mod-high	3	low	1
Wildlife	low	3	low	2	nil	1
Aquatic Resources	mod	3	mod	2	low	1
Agriculture	nil	-	nil	-	nil	-
Forestry	high	3	high	2	low-mod	1
Mining	slightly beneficial	1	slightly beneficial	1	low	3
Heritage Resources*[1]	-	2	-	1	-	3
Recreation	slightly beneficial	1	slightly beneficial	2	low	3
Visual Resources	moderate	3	moderate	2	low-mod	1
Land Status and Use	low	2	nil-low	1	low-high	3
Human Environment*[1]			preference not yet determined			

Preferred Alternative: Rainbow (B) - Tyee (D)

* PR = Preference Ranking

*1 No formal ratings can be assigned for Human Environment until completion of the study on Indian bands. From the Heritage Resources perspective, the Prudhomme-Lachmach alternatives are preferred.

to the north of the knolls on the north side of Minerva Lake (Maps IS-1, IS-2) to avoid visual impacts.

The choice of the Rainbow-Tyee alternative would mean low impacts for recreation and mining. Recreation impacts stem largely from the visual and noise impacts near Prudhomme Lake Provincial Park during construction. High impacts for land status and use would result from the presence of small private residential properties directly on the route. All other resources would receive lower or similar impacts with this alternative than with the Prudhomme-Lachmach alternatives.

The environmental impacts of the Rainbow-Tyee alternative were judged to be less overall than those of the Prudhomme-Lachmach alternatives.

(b) Telegraph (H) vs Ayton (G)

In the Telegraph segment the impacts (Section 5.2.10) on all resources except surficial geology, forestry and mining would be equal to or lower than those (Section 5.2.9) in the Ayton segment (Table 6-2). Impacts would be higher for wildlife, agriculture, recreation and visual resources in the Ayton segment.

The principle wildlife concern is that the Ayton Islands crossing would be a disturbance to waterfowl during construction as well as a hazard to waterfowl and eagles throughout the life of the line. A nearby goat population is sensitive to disruption from construction activities. The potential visual impact of an additional crossing of the Skeena River is considered high. The recreation rating reflects the anticipated changes in visual landscape and in wildlife viewing opportunities. The low agricultural rating reflects the traversing of land in the Agricultural Land Reserve.

Slope failure and gullying are possible in the Telegraph segment. Adverse effects would be minor since helicopters would probably be used for construction and maintenance. The low mining rating is due

TABLE 6-2

TELEGRAPH vs AYTON
SEGMENT COMPARISON

	Telegraph (H)		Ayton (G)	
Resource	Impact Rating	PR*	Impact Rating	PR*
Surficial Geology	low	2	nil	1
Vegetation	low	1	low	2
Wildlife	low	1	moderate	2
Aquatic Resources	nil	-	nil	-
Agriculture	nil	1	low	2
Forestry	moderate	2	moderate	1
Mining	low	2	nil	1
Heritage Resources*[1]	-	1	-	2
Recreation	nil	1	moderate	2
Visual Resources	low	1	high	2
Land Status and Use	low	-	low	-
Human Environment		preference not yet determined		

Preferred Alternative: Telegraph (H)

* PR = Preference Ranking

*1 No formal ratings were assigned for Heritage Resources but the Telegraph segment is slightly preferred.

to the crossing of a borrow area. Forest land is better quality in this segment so forest losses would be greater.

The impacts of a second transmission line along the Telegraph segment would be overall less severe than with a new line along the Ayton segment, therefore the Telegraph segment is strongly preferred.

(c) Kasiks (K) vs Mt. Bucey (J)

The impacts of a transmission line along the Mt. Bucey segment would be equal to or lower than for the Kasiks segment for all disciplines except vegetation (Table 6-3). The greatest differences between segments would be in wildlife and visual resources. Wildlife effects in the Kasiks segment include disturbance and alteration of important trumpeter swan and moose wintering habitats. High visual impacts cannot be mitigated because they occur at road and water crossings. The potential disturbance to the human environment is unknown at present pending discussion with Indian bands. The agricultural rating is high, reflecting the area's potential as a future agricultural development area. Forestry losses would be high in both segments.

The Mt. Bucey segment is the strongly preferred alternative. At km 60.2, the new line should continue along the southeast side of the existing right-of-way until km 65.7S where it could cross to the north side of the existing line. This change would be beneficial because the clearing of an area of coniferous cover important to moose would be avoided.

The study team also considered recommending alternatives between 70.0S and 86.5 which would parallel the existing right-of-way on the south side of the Skeena River (Maps IS-4, IS-5). For nearly all resources, adverse effects would be significantly less if one of the southern alternatives were chosen (Table 6-4 and Appendix I). These alternatives offer the opportunity of avoiding degradation of important habitat for moose, waterfowl and furbearers at the mouth of the Kasiks River. Losses to wildlife habitat on the southern route

TABLE 6-3

KASIKS vs MT. BUCEY
SEGMENT COMPARISON

	Kasiks (K)		Mt. Bucey (J)	
Resource	Impact Rating	PR*	Impact Rating	PR*
Surficial Geology	nil	-	nil	-
Vegetation	low	1	low	2
Wildlife	high	2	low	1
Aquatic Resources	low	2	low	1
Agriculture	high	2	moderate	1
Forestry	moderate	2	moderate	1
Mining	low	2	nil	1
Heritage Resources*[1]	-	2	-	1
Recreation	moderate	2	low	1
Visual Resources	high	2	low	1
Land Status and Use	low	2	nil	1
Human Environment		preference not yet determined		

Preferred Alternative: Mt. Bucey (J)

* PR = Preference Ranking

*1 No formal ratings were assigned but the Mt. Bucey segment is slightly preferred with respect to Heritage Resources.

TABLE 6-4

SOUTHERN vs NORTHERN ALTERNATIVES COMPARISON (km 70.0S to km 86.5)

	Impact Ratings			
	Southern Alternatives		North Alternatives (K, L, part O)	
Resource	Parallel line	Islands	With N	With M
Surficial Geology	low-mod	low-mod	low-mod	low-mod*1
Vegetation	low*1	low*1	low	low
Wildlife	low*1	moderate	low-high	low-high
Aquatic Resources	low*1	low*1	low	low-mod
Agriculture	low-mod*1	low-mod*1	high	high
Forestry	moderate*1	moderate*1	moderate	moderate
Mining	nil*1	nil*1	low	low
Heritage Resources	-*1	-*1	-	-
Recreation	low*1	low*1	moderate	low-mod
Visual Resources	low*1	low*1	low-high	low-high
Land Status and Use	high	nil	low	low
Human Environment		preference not yet determined		

Preferred Alternatives: Southern Alternatives

*1 Preferred.

would be low if the new line was adjacent to the existing line. If built on the islands at the mouth of the Gitnadoix, however, the line would be a potential collision hazard to swans.

Losses of potential agricultural land on the southern alternatives would be less than on the northern routes as lands of lower capability would be crossed. The probability of detrimental effects on aquatic resources would be lower due to fewer crossings of the Skeena mainstem and avoidance of the Exchamsiks Crescent segment. Adverse effects on recreation and visual resources would be low in comparison to those associated with transmission crossings of the road, river and Exchamsiks Crescent or Ridge. Only surficial geology effects may be more problematic with the southern alternatives. If the southern alternative paralleled the existing line, IR 75 (Gitandoiks) would be traversed. There are three other reserves on the south side of the Skeena River and two in close proximity to the northern alternatives. Until further discussion with the Indian bands that utilize the reserves and the area's resources, no preference from a human environment perspective can be expressed.

Overall, a clear environmental rationale has been developed for preferring a southern alternative. It is understood, however, that terrain hazards and other engineering constraints may prove too difficult or costly to overcome.

(d) Exchamsiks Ridge (N) vs Exchamsiks Crescent (M)

The Exchamsiks Crescent segment has been given slightly lower ratings for almost all resources except aquatic resources (Table 6-5). Visual impacts would remain high with either alternative. Visual aspects influence the high recreation rating given to the Ridge segment because Exchamsiks River Provincial Park is intensively used and offers a full view of the ridge. Surficial geology and forestry impacts are expected to be moderate and low to moderate respectively on the Ridge as opposed to low and nil respectively on the alternative Crescent segment.

TABLE 6-5

EXCHAMSIKS RIDGE vs EXCHAMSIKS CRESCENT SEGMENT COMPARISON

	Exchamsiks Ridge (N)		Exchamsiks Crescent (M)	
Resource	Impact Rating	PR*	Impact Rating	PR*
Surficial Geology	moderate	2	low	1
Vegetation	low	2	low	1
Wildlife	low	2	nil	1
Aquatic Resources	nil	1	moderate	2
Agriculture	low	2	nil	1
Forestry	low-mod	2	low-nil	1
Mining	nil	-	nil	-
Heritage Resources		no preference		
Recreation	high	2	moderate	1
Visual Resources	high	-	high	-
Land Status and Use	low	2	nil	1
Human Environment		preference not yet determined		

Preferred Segment: Exchamsiks Ridge (N)

* PR = Preference Ranking

Note: If aquatic resources concerns can be addressed, the preferred segment would be Exchamsiks Crescent (M).

Aquatic resources may be adversely affected to a moderate degree on the Crescent segment but not at all on the Ridge segment because towers would have to be built in the river itself causing degradation of pink and chum salmon spawning areas downstream. Because of the importance of aquatic resources in the area, the potential harm to fisheries along the Crescent segment outweigh the combined impacts on other resources along the Ridge segment. The Ridge segment is marginally preferred unless construction practices are outlined which appear to cause a minimum of interference with the aquatic habitat. The need to use either of these segments would disappear if the southern alternatives discussed in (c) were chosen.

(e) Hudson (P) - Dasque (W) vs Exstew (Q) - Crossing (S) - Dasque (W) vs Exstew (Q) - Exstew East (V) - Shames South (Y) - Klakelse Crossing (Z) vs Exstew (Q) - Exstew East (V) - Shames North (X) - Klakelse Crossing (Z)

The Hudson-Dasque alternative is clearly the preferred one for most resources except aquatic resources and, to a lesser degree, surficial geology and forestry (Table 6-6). Aquatic resources could experience moderate impacts due to the proximity of the route to sensitive spawning and rearing areas. Therefore, because of the importance of this resource to the study area and the region as a whole, the route was not chosen as the preferred alternative.

The alternatives which would traverse the least important aquatic resources habitats are those which include Shames South (QVYZ) and Shames North (QVXZ). The alternative which includes Shames South has the greatest overall potential for environmental impacts of the four choices, including the greatest potential for adverse effects on wildlife, agriculture, visual resources and land status, and for significant detrimental effects on surficial geology, vegetation, forestry and recreation. The Shames South and adjacent segments traverse moose winter range, two trumpeter swan wintering areas near the Shames and Exstew rivers, as well as waterfowl and furbearer habitat. The transmission line would present a severe collision hazard to the swans and other waterfowl to a lesser extent. The agricultural land at Shames is the only vegetable-producing area west

TABLE 6-6

HUDSON-DASQUE vs EXSTEW-CROSSING-DASQUE vs EXSTEW-EXSTEW EAST-SHAMES SOUTH-KLAKELSE CROSSING vs EXSTEW-EXSTEW EAST-SHAMES NORTH-KLAKELSE CROSSING

COMPARISON OF ALTERNATIVES

	Hudson (P) - Dasque (W)		Exstew (Q) - Crossing (S) - Dasque (W)		Exstew (Q) - Exstew East (V) - Shames South (Y) - Klakelse Crossing (Z)		Exstew (Q) - Exstew East (V) - Shames North (X) - Klakelse Crossing (Z)	
Resource	Impact Rating	PR*	Impact Rating	PR*	Impact Rating	PR*	Impact Rating	PR*
Surficial Geology	low	2	low	1	moderate	3	moderate	4
Vegetation	low	1	low	2	low-high	3	low-high	4
Wildlife	moderate	1	moderate	2	high	4	mod-high	3
Aquatic Resources	moderate	4	low	3	low	2	low	1
Agriculture	low	1	low	1	high	4	low	1
Forestry	moderate	2	low-mod	1	moderate	3	moderate	4
Mining	nil	1	low	3	low	4	low	2
Heritage Resources	no preference							
Recreation	low	1	moderate	2	moderate	3	moderate	3
Visual Resources	low	1	low	2	high	4	moderate	3
Land Status and Use	low	1	low	2	moderate	3	low	2
Human Environment	preference not yet determined							

Preferred Alternative: Exstew (Q) - Crossing (S) - Dasque (W)

* PR = Preference Ranking.

of Terrace and has high agricultural capability. A number of private properties and other alienated lands would be traversed. Visual resources would be impacted because the transmission line would cross and parallel the highway throughout most of its length.

The Shames North and adjacent segments avoid the agriculture and land status problems of the Shames South segment, but have the greatest forestry losses of the four choices. Considerable areas of good and medium forest growing sites would be traversed. The impacts on wildlife, recreation, surficial geology, vegetation and visual resources are similar to those of the Shames South group. Shames North avoids one swan wintering area but introduces a potential disturbance to goats on the mountainside north of the segment. Visual resources effects would not be as noticeable because the transmission line would not parallel the highway for as great a distance.

In an attempt to keep adverse effects on all resources to a minimum, a compromise route was proposed which would reduce aquatic resource impacts from the level of the Hudson-Dasque alternative, increase forestry, mining and recreation impacts slightly and maintain other resource impacts at the Hudson-Dasque alternative levels. This alternative, Exstew-Crossing-Dasque, would avoid the most important swan-waterfowl areas and the moose wintering area as would Hudson-Dasque. Exstew-Crossing-Dasque also avoids salmon spawning areas near 94S, 96S and 97S. It does encroach unavoidably on the spawning area at 100.6. Recreational impacts, as in the Shames alternatives, remain moderate primarily due to effects on wildlife viewing and fishing activities at the Exstew River.

Overall, the Exstew-Crossing-Dasque alternative is recommended as the best route given important resource values along all the routes. Because of the high resource sensitivities (especially wildlife and aquatic resources) surrounding this route, any minor changes from the route as shown on the maps may have serious repercussions. Deviations should be considered with the input of the environmental officer and the appropriate environmental specialists.

An additional recommendation is that the new route follow the existing right-of-way as closely as possible between km 108 to km 113S, keeping new clearing to a minimum. The objective is to reduce visibility into the moose habitat-marsh areas from the transmission line access road and, therefore, the possibility of overhunting.

When consultation with Indian bands has occurred, new perspectives on the importance and value of the resources may be gained, and this route decision, like the ones which have preceded it, are subject to change. New information may change the likelihood or predicted severity of residual impacts.

6.3 ENVIRONMENTALLY PREFERRED ROUTE

The environmentally preferred route is shown on Maps IS-1 to IS-7. Where there are alternatives, the preferred route alternatives from west to east are: Rainbow-Tyee, Telegraph, Mt. Bucey, Exchamsiks Ridge, and Exstew-Crossing-Dasque. The total segment sequence in the preferred route is A, B, D, F, H, I, J, L, N, O, Q, S, W, and R. If technically feasible, the southern alternative indicated on Maps IS-4 to IS-5 is preferred in lieu of part of J, L, N and part of O.

The potential impacts on all the resources in the study area have been crucial in determining the preferred route. The recommendations on route changes have been carefully considered to avoid reducing impacts on one resource to the detriment of another.

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APPENDIX A

HYDROLOGY

DERIVED DISCHARGE RECORDS FOR THE SKEENA RIVER NEAR THE MOUTH

APPENDIX A

HYDROLOGY
DERIVED DISCHARGE RECORDS FOR THE SKEENA RIVER NEAR THE MOUTH

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APPENDIX A

HYDROLOGY

DERIVED DISCHARGE RECORDS FOR THE SKEENA RIVER NEAR THE MOUTH

The most westerly Water Survey of Canada gauging station on the Skeena River system is located at Usk, 20 km upstream of Terrace. Consequently, the lower 130 km of the Skeena River is ungauged and only 6 of 11 major tributaries of the lower Skeena have even partial discharge records. The estimated total basin area of the Skeena River system is 58 000 km². Approximately 75 percent of that area has discharge data. By using a rough estimate of the discharge in the ungauged tributary basins and the records of similar nearby streams, a derived hydrograph for the lower Skeena River has been produced (Fig. 4.1-3).

The gauging stations which provide relevant data for these calculations are listed in Table A-1 and include:

1. Skeena River at Usk

Major tributaries below Usk, with continuous records:

2. Zymoetz River above O.K. Creek
3. Zymagotitz River
4. Exchamsiks River

Major tributaries below Usk, with discontinuous records:

5. Kitsumkalum River
6. Zymoetz River at Terrace
7. Lakelse River
8. Khtada River

The major tributaries which are ungauged include the Exstew, Gitnadoix, Khyex, Kasiks and Scotia rivers. Smaller tributaries, particularly on the south side of the lower Skeena, are also ungauged. By extrapolating monthly mean discharges from the nearest similar gauged basin, rough estimates for these ungauged areas were obtained. The derived mean monthly and annual discharges are listed in Table A-2.

TABLE A-1

DISCHARGE SUMMARY - SKEENA RIVER AND TRIBUTARIES
DATA FROM WATER SURVEY OF CANADA, 1980

1. SKEENA RIVER AT USK - Station No. 08EF001
- Period of Record 1928 to 1979
- Basin Area 42 217 km^2

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
193	171	145	371	1840	2840	1780	996	740	842	550	298	919

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge*1 (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)*2
8100 [12 June 1972]	9340 [26 May 1948]	51.8 [1 March 1950]	29 000 000

2. ZYMOETZ RIVER ABOVE OK CREEK - Station No. 08EF005
- Period of Record 1963 to 1979
- Basin area 2978 km^2

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
22	21	20	40	173	319	224	143	104	120	59	32	108

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)
3140 [1 November 1978]	1980 [1 November 1978]	7.9 [18 March 1969]	3 400 000

3. ZYMACOTITZ RIVER NEAR TERRACE - Station No. 08EG011
- Period of Record 1960 to 1979
- Basin Area 376 km^2

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
5	6	6	14	35	57	47	32	25	32	17	8	24

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)*2
549 [15 October 1974]	382 [15 October 1974]	1.5 [18 March 1969]	749 000

TABLE A-1 - (Cont'd)

4. EXCHAMSIKS RIVER NEAR TERRACE - Station No. 08EG012
- Period of Record 1962 to 1979
- Basin Area 370 km²

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
9	9	9	22	55	86	84	71	62	64	30	13	43

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge*1 (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)*2
864 [1 November 1978]	572 [15 October 1974]	1.5 [18 March 1969]	1 350 000

5. KITSUMKALUM RIVER NEAR TERRACE - Station No. 08EG006
- Period of Record 1929 to 1950
- Basin Area 2176 km²

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
38	31	24	55	177	286	238	187	147	144	104	60	123

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge*1 (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)*2
882.9 [3 June 1936]	882.9 [3 June 1936]	7.7 [15 March 1933]	3 886 800

6. ZYMOETZ RIVER NEAR TERRACE - Station No. 08EF003
- Period of Record 1952 to 1964
- Basin Area 3080 km²

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
39	39	26	47	245	358	255	161	123	167	105	59	138

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

Maximum Instantaneous Discharge*1 (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)	Mean Annual Total Discharge (dam^3)*2
No Record	1050 [31 October 1961]	8.2 [3 March 1952]	4 350 000

TABLE A-1 - (Cont'd)

7. LAKELSE RIVER NEAR TERRACE - Station No. 08EG007
- Period of Record 1948 to 1955 (partial)
- Basin Area 388 km²

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
-	-	-	10	23	36	19	15	15	31	-	-	-

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

No Extremes Recorded

8. KHTADA RIVER NEAR KWINITSA - Station No. 08EG003
- Period of Record 1929 to 1931 (partial)
- Basin Area 153 km²

MONTHLY AND ANNUAL MEAN DISCHARGE
(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
14	10	4	10	14	21	14	8	12	23	23	20	-

EXTREMES AND MEAN ANNUAL TOTAL DISCHARGE

No Extremes Recorded

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*[1] Period of record 1953 to 1979.

*[2] $dam^3 = 10^3 m^3$; 1 acre-ft. = 1.2325 dam^3.

TABLE A-2

DERIVED DISCHARGE DATA - LOWER SKEENA RIVER
MONTHLY AND ANNUAL MEAN DISCHARGE*1
(m^3/s)

Basin	Station	Conversion Factor	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Upper Skeena	Skeena at Usk	-	196	173	145	362	1854	2858	1797	1115	750	838	552	306	928
Zymoetz	Zymoetz nr. Terrace	-	39	38	26	47	245	359	255	160	123	167	105	159	138
Zymagotitz	Zymagotitz at Terrace	-	5	5	5	13	36	58	49	32	26	31	16	8	24
Exchamsiks	Exchamsiks nr. Terrace	-	10	8	8	20	55	87	86	71	65	62	29	13	43
Kitsumkalum	Kitsumkalum nr. Terrace	-	38	31	24	55	177	286	238	187	147	144	104	60	123
Khtada	Khtada nr. Kwinitsa	-	14	10	4	10	14	21	14	8	12	23	23	20	14 E
Lakelse	{ Lakelse nr. Terrace	-	-	-	-	10	23	36	19	15	15	31	-	-	-
	Kitsumkalum nr. Terrace	÷ 5.25	7 E	6 E	5 E	-	-	-	-	-	-	-	20 E	11 E	17 E
Exstew	Exchamsiks nr. Terrace	÷ 1.5	7 E	5 E	5 E	13 E	37 E	58 E	58 E	47 E	43 E	41 E	19 E	9 E	29 E
Gitnadoix	Khtada nr. Kwinitsa	x 4	56 E	40 E	16 E	40 E	56 E	84 E	56 E	32 E	48 E	92 E	92 E	80 E	58 E
Khyex	Exchamsiks nr. Terrace	x 1	10 E	8 E	8 E	20 E	55 E	87 E	86 E	71 E	65 E	62 E	29 E	13 E	43 E
Kasiks	Exchamsiks nr. Terrace	÷ 2	5 E	4 E	4 E	10 E	27 E	43 E	43 E	35 E	32 E	31 E	15 E	7 E	21 E
Scotia	Khtada nr. Kwinitsa	÷ 1.5	9 E	7 E	2 E	7 E	9 E	14 E	9 E	5 E	8 E	15 E	15 E	13 E	9 E
Other N. Shore Tributaries	Zymagotitz at Terrace	x 1.5	6 E	6 E	6 E	19 E	54 E	87 E	75 E	48 E	39 E	46 E	24 E	12 E	36 E
Other S. Shore Tributaries	Khtada nr. Kwinitsa	x 3	42 E	30 E	12 E	30 E	42 E	63 E	42 E	24 E	36 E	69 E	69 E	60 E	42 E
Skeena at Tyee	Derived - Σ 15 above Basins	-	444 E	371 E	270 E	656 E	2684 E	4141 E	2825 E	1850 E	1409 E	1652 E	1112 E	771 E	1525 E

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*1 Based on various periods of record up to 1976.

E - Estimated Data

APPENDIX B

VEGETATION TYPES IN THE SKEENA-RUPERT STUDY AREA

APPENDIX B

VEGETATION TYPES IN THE SKEENA-RUPERT STUDY AREA

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B-1	Scientific Names for Plants Mentioned in the Text
B-2	Vegetation Types in the Skeena-Rupert Study Area
B-3	Rare or Endangered Plant Species of the Skeena-Rupert Study Area

TABLE B-1

SCIENTIFIC NAMES FOR PLANTS MENTIONED IN THE TEXT

Common Name	Scientific Name
Alaska blueberry	*Vaccinium alaskaense*
alder	*Alnus* sp.
amabilis fir	*Abies amabilis*
amphibious rush	*Juncus oreganus*
aquatic buttercup	*Ranunculus aquatilis*
aster	*Aster subspicatus*
Austin's phantom orchid	*Eburophyton austinae*
Baltic rush	*Juncus balticus*
beach lovage	*Ligusticum scoticum*
bentgrass	*Agrostis exarata*
big huckleberry	*Vaccinium membranaceum*
black cottonwood	*Populus trichocarpa*
black twinberry	*Lonicera involucrata*
bladderwort	*Utricularia* spp.
blueberry	*Vaccinium* sp.
bluejoint	*Calamagrostis canadensis*
bog bean	*Menyanthes trifoliata*
bog blueberry	*Vaccinium uliginosum*
bog laurel	*Kalmia polifolia*
bog rosemary	*Andromeda polifolia*
bulrush	*Scirpus validus*
bunchberry	*Cornus canadensis*
burnet	*Sanguisorba officinalis*
bur reed	*Sparganium* sp.
buttercup	*Ranunculus* sp.
chocolate lily	*Fritillaria kamschatcensis*
common horsetail	*Equisetum arvense*
coontail	*Myriophyllum spicatum*
cotton grass	*Eriophorum angustifolium*
copperbush	*Cladothamnus pyroliflorus*
crabapple	*Pyrus fusca*
crowberry	*Empetrum nigrum*
deer cabbage	*Fauria crista-galli*
deer fern	*Blechnum spicant*
devil's club	*Oplopanax horridus*
dwarf azalea	*Loiseluria procumbens*
dwarf blueberry	*Vaccinium caespitosum*
elderberry	*Sambucus* sp.
enchanter's nightshade	*Circaea alpina*

TABLE B-1 - (Cont'd)

Common Name	Scientific Name
false azalea	Menziesia ferruginea
false lily-of-the-valley	Maianthemum dilatatum
fireweed	Epilobium sp.
flowering quillwort	Lilaea scilloides
foamflower	Tiarella trifoliata
giant vetch	Vicia gigantea
gnome plant	Hemitomes congestum
goldthread	Coptis trifolia
hairgrass	Deschampsia caespitosa
high bush cranberry	Viburnum edule
Laborador tea	Ledum groenlandicum
lady fern	Athyrium filix-femina
lichens	Cladina sp. Stereocaulon sp.
lingonberry	Vaccinium vitis-idaea
liverworts	Anastrophyllum donianum Lepidozia sandvicensis
lodgepole pine	Pinus contorta var. Catifolia
manna grass	Glyceria occidentalis
marsh marigold	Caltha biflora
meadow horsetail	Equisetum pratense
mosses	Bryhnia hultenii Campyplopus schwarzii Habrodon leucotrichus Hylocomium splendens Isoptertgiopsis muelleriana Pleuroziopsis ruthenica Pleurozium schreberi Rhytidiadelphus loreus R. triquetrus Sematophyllum micans Sphagnum aongstroemii
mountain hemlock	Tsuga mertensiana
mudwort	Limosella aquatica
oak fern	Gymnocarpium dryopteris
oval-leaf huckleberry	Vaccinium ovalifolium
pearly everlasting	Anaphalis margaritacea
pink pyrola	Pyrola asarifolia
pipsissewa	Chimaphila umbellata
pondweed	Potamogeton spp.
queen's cup	Clintonia uniflora

TABLE B-1 - (Cont'd)

Common Name	Scientific Name
red alder	Alnus rubra
red huckleberry	Vaccinium parvifolium
red osier dogwood	Cornus stolonifera
reindeer lichen	Cladonia rangiferina
rushes	Juncus sp.
salal	Gaultheria shallon
salmonberry	Rubus spectabilis
sea watch	Angelica lucida
sedges	Carex sp.
shore pine	Pinus contorta
Sitka mountain ash	Sorbus sitchensis
Sitka spruce	Picea sitchensis
silverweed cinquefoil	Potentilla pacifica
skunk cabbage	Lysichitum americanum
slough sedge	Carex obnupta
small-fruited bulrush	Scirpus microcarpus
speed-well	Veronica americana
spike rush	Eleocharis sp.
spiny wood fern	Dryopteris austriaca
spreading juniper	Juniperus communis
starflower	Trientalis arctica
stink current, blue current	Ribes bracteosum
strawberry bramble	Rubus pedatus
stream violet	Viola glabella
sundews	Drosera sp.
sweet gale	Myrica gale
thimbleberry	Rubus parviflorus
trailing bramble	Rubus ursinus
twinflower	Linnaea borealis
twisted stalk	Streptopus amplexifolius
wapato	Sagittaria latifolia
water hemlock	Cicuta douglasii
water parsley	Oenanthe sarmentosa
water parsnip	Sium suave
water plantain	Alisma plantago-aquatica
water star	Callitriche sp.
western hemlock	Tsuga heterophylla
western rattlesnake plantain	Goodyera oblongifolia
western red cedar	Thuja plicata
western twayblade	Listera caurina
white gentian	Gentiana douglasiana
wigeon grass	Ruppia maritima
wild cranberry	Vaccinium oxycoccos
willow	Salix sp.
wintergreen	Gaultheria sp.
yellow cedar, yellow cypress	Chamaecyparis nootkatensis
yellow water lily	Nuphar polysepalum

TABLE B-2

VEGETATION TYPES IN THE SKEENA-RUPERT STUDY AREA

Vegetation Type	Zone of Occurrence in Study Area	Previously Identified Types or Communities Included	Reference
Low-salinity tidal marsh	CCPH, CWH	Low-salinity tidal marsh	TERA 1975
Bog-muskeg	CCPH	Open bog	Banner 1980
		Outcrop	Banner 1980
		Bog woodlands	Banner 1980
	CCPH, CWH	Coastal muskeg	TERA 1975
	CWHf*[1]	Bog	Pojar 1980
Coastal forest	CCPH	Cedar-cypress-hemlock	Banner 1980
		Fir-hemlock-cedar	Banner 1980
	CWHf	Hemlock-*Vaccinium*-moss	Pojar 1980
		Devil's club-oak fern	Pojar 1980
	CCPH, CWH	Hemlock-cedar	TERA 1975
		Cedar-hemlock	TERA 1975
Alluvial-conifer forest	CCPH	Alluvial forest	Banner 1980
	CCPH, CWH	Riparian forest	TERA 1975
	CWHf	Devil's club-lady fern-oak fern	Pojar 1980
		Skunk cabbage	Pojar 1980
Successional communities	CCPH, CWH	Successional vegetation	TERA 1975
Aquatic communities	CCPH, CWH	Freshwater aquatic	TERA 1975
Black cottonwood	CWH*[2]	Black cottonwood	Pojar 1980
Pine forest	CWHf	Lodgepole pine-hemlock-moss	Pojar 1980
		Dry hemlock-moss	Pojar 1980
Montane communities	MH	Montane vegetation	TERA 1975

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*[1] The small f signifies the amabilis fir-spruce or drier subzone of the CWH biogeoclimatic zone.

*[2] Pojar's description of the CWHf subzone includes this association. No delineation of associations within the CWHi (wetter) subzone has been made, but the type is present in both subzones.

TABLE 8-3

RARE OR ENDANGERED PLANT SPECIES OF THE SKEENA-RUPERT STUDY AREA

Species	Habitat Description	Vegetation Type	Status*[1]	Reference
Brynnia hultenii	swamps, near streams or rivers, on logs	bog-muskeg alluvial conifer forest aquatic communities	infrequent, endangered	(Schofield, pers. com.)
Campyplopus schwarzii	cliffs overhanging river	montane communities	infrequent, endangered	(Schofield, pers. com.)
Habrodon leucotrichus	epiphyte on yellow cypress or shore pine	bog-muskeg coastal forest	infrequent, endangered	(Schofield, pers. com.)
Isoptertgiopsis muelleriana	humid cliffs		infrequent, endangered	(Schofield, pers. com.)
Pleuroziopsis ruthenica	floodplain areas	alluvial conifer forest	infrequent, endangered	(Schofield, pers. com.)
Sematophyllum micans	on rocks at high elevations	montane communities	rare infrequent, endangered	(Schofield 1969) (Schofield, pers. com.)
Sphagnum aongstroemii	localized, on cliffs	montane communities	infrequent, endangered	(Schofield, pers. com.)
Anastrophyllum donianum	high elevation areas	montane communities	rare	(Schofield, pers. com.)
Lepidozia sandvicensis	wet areas near coast	bog-muskeg	rare	(Schofield, pers. com.)
spiny woodfern	mountains, open rocky slopes	pine forest	rare (R3)	(Taylor 1977) (Pojar, pers. com.)
water star	aquatic, rooted in mud	tidal marsh aquatic communities	occasional in west rare (R4) uncommon	(Taylor 1977) (TERA 1975)*[2] (Pojar 1975)
dwarf azalea	bogs	bog-muskeg	infrequent rare	(TERA 1975)
gnome plant	coniferous forests in deep humus	pine forest	rare (R3) rare	(Taylor 1977) (Pojar, pers. com.)
white gentian	bogs, tundra, lake margins	bog-muskeg aquatic communities	uncommon	(TERA 1975)
mudwort	shallow water or wet mud	tidal marsh aquatic communities	rare (R3) infrequent	(Taylor 1977) (Pojar 1975)
wapato	swamps, ditches, ponds, lakes	tidal marsh bog-muskeg aquatic communities	rare rare, northernmost range rare (R3)	(TERA 1975) (TERA 1975) (Taylor 1977)
water plantain	marshy areas	tidal marsh bog-muskeg	northernmost range rare, northernmost range	(Pojar 1975) (TERA 1975)
flowering quillwort	shallow water or mud at edge of ponds, tidal flats to interior valleys	tidal marsh bog-muskeg aquatic communities	northernmost range (R1) very rare, northernmost range	(Pojar 1975) (Taylor 1977) (TERA 1975)
slough sedge	wet ground, standing water along rivers or coastal swamps	tidal marsh bog-muskeg alluvial conifer forest	northernmost range northernmost range	(Pojar 1975) (TERA 1975)
chocolate lily	moist areas near tide flats to mountain meadows	tidal marsh	fast disappearing uncommon, endangered	(TERA 1975)
Austin's phantom orchid	moist deep coniferous forest	coastal forest alluvial conifer forest	unconfirmed sighting	(Pojar, pers. com.)
western twayblade orchid	moist places lowland to subalpine	coastal forest	rare (R1) uncommon	(Taylor 1977) (TERA 1975)

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*[1] Taylor (1977) gives a preliminary list of rare plants in British Columbia according to the following degrees of rarity:

R1	Single or few populations	R2	Several populations, locally common
R3	Widespread or scattered distribution	R4	Restricted distribution, large populations

*[2] (TERA) TERA Environment Resource Analysts

APPENDIX C

SCIENTIFIC NAMES OF WILDLIFE SPECIES IN THE STUDY AREA

APPENDIX C

SCIENTIFIC NAMES OF WILDLIFE SPECIES IN THE STUDY AREA

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TABLES

Table No.

C-1 Scientific Names of Wildlife Species

TABLE C-1

SCIENTIFIC NAMES OF WILDLIFE SPECIES IN THE STUDY AREA

Mammals (Cowan and Guiget 1965)

Beaver	*Castor canadensis*
Black bear	*Ursus americanus*
Cougar	*Felis concolor*
Coyote	*Canis latrans*
Fisher	*Martes pennanti*
Flying squirrel	*Glaucomys sabrinus*
Grizzly bear	*Ursus arctos*
Hair (harbour) seal	*Phoca vitulina*
Lynx	*Lynx canadensis*
Marten	*Martes americana*
Mink	*Mustela vison*
Moose	*Alces alces*
Mountain goat	*Oreamnos americanus*
Mule deer	*Odocoileus hemionus hemionus*
Muskrat	*Ondatra zibethica*
Otter	*Lutra canadensis*
Red fox	*Vulpes fulva*
Red squirrel	*Tamiasciurus hudsonicus*
Short-tailed weasel (ermine)	*Mustela erminea*
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*
Wolf	*Canis lupus*
Wolverine	*Gulo luscus*

Birds (Robbins et al. 1966)

American widgeon	*Mareca americana*
Bald eagle	*Haliaeetus leucocephalus*
Band-tailed pigeon	*Columba fasciata*

TABLE C-1 - (Cont'd)

Blue grouse	*Dendragapus obscurus*
Blue-winged teal	*Anas discors*
Bufflehead	*Bucephala albeola*
Canada goose	*Branta canadensis*
Common merganser	*Mergus merganser*
Goldeneye	*Bucephala* spp.
Green-winged teal	*Anas carolinensis*
Mallard	*Anas platyrhynchos*
Pintail	*Anas acuta*
Ptarmigan	*Lagopus* spp.
Red-breasted merganser	*Mergus serrator*
Ruffed grouse	*Bonasa umbellus*
Scaup	*Aythya* spp.
Scoter	*Melanitta* spp., *Oidemia nigra*
Shoveller	*Spatula clypeata*
Snow goose	*Chen hyperborea*
Trumpeter swan	*Olor buccinator*
Whitefronted goose	*Anser albifrons*

Reptiles (British Columbia Fish and Wildlife Branch 1979g) and Amphibians (British Columbia Fish and Wildlife Branch 1980a)

Boreal toad	*Bufo boreas*
Brown salamander	*Ambystoma gracile*
Common garter snake	*Thamnophis sirtalis*
Northern roughskin newt	*Taricha granulosa*
Spotted frog	*Rana pretiosa*
Western terrestrial garter snake	*Thamnophis elegans*

APPENDIX D

AQUATIC RESOURCES

APPENDIX D

AQUATIC RESOURCES

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APPENDIX D

AQUATIC RESOURCES

D.1 INTRODUCTION

The aquatic resources study focused on the salmonid resources of the study area because of their sensitivity to environmental change and importance to commercial, sport and native food fisheries. The study utilized three main sources of information: (1) published reports and scientific papers; (2) unpublished government agency resource data; and (3) field surveys to fill important data gaps and to gain familiarity with the proposed transmission line routes. Field work concentrated on documentation of salmon spawning distribution in the Skeena River mainstem and physical features of streams crossed or paralleled by the proposed routes. This Appendix describes study methods and presents observations and data obtained in the study.

D.2 AGENCY CONTACTS

Individuals in the federal and provincial government resource agencies were contacted over the period August to December 1980 to obtain information on salmonid resources of the study area, to determine their concerns with respect to potential impact of the project and to obtain recommendations relating to impact mitigation. Contacts were also made with individuals in B.C. Hydro regarding route engineering, construction practices and right-of-way vegetation control policies. A list of individuals contacted is presented in Appendix K.

D.3 PHYSICAL SURVEY

A helicopter reconnaissance of the proposed transmission line routes was conducted on 20 August 1980. Ground surveys to document the physical characteristics of streams at proposed route crossings were carried out from 21 August to 1 December. Information collected at stream crossing points included: wetted and total width; bank height, composition and evidence of erosion; general flow characteristics (pool, run, riffle, rapid); rough estimate of flow volume (using average surface velocity and depth); stream depth and substrate composition; presence of suitable spawning area; and the slope and character of the approaches to the crossing. In some cases, the stream was surveyed for some distance downstream of the proposed crossing point to assess general habitat potential for salmonid spawning and rearing.

A summary of physical survey observations at each site is presented in Table D-1.

D.4 SALMONID RESOURCE INVENTORY

Available data on the presence and abundance of salmonid fish in waterbodies crossed or paralleled by the proposed routes are summarized in Table D-2. The data are also plotted on the resource map accompanying this report. Sources of the above material were:

1. Department of Fisheries and Oceans Annual Reports of Salmon Streams and Spawning Grounds.
2. Unpublished Resource Analysis Branch stream inventory data.
3. Published Fish and Wildlife Branch steelhead harvest analyses.
4. Unpublished data on Fish and Wildlife Branch files in Smithers.

TABLE D-1

SUMMARY OF PHYSICAL SURVEY DATA COLLECTED IN 1980 AT STREAM CROSSINGS ALONG PROPOSED ROUTES FOR THE SKEENA-RUPERT TRANSMISSION LINE

Stream	Route Kilometre Post	Date	Area Inspected	Approx. Width		Bank Character	Flow Character and Volume	Comments
				Wetted	Total			
Kloiya River	4	Dec. 15	At crossing point	12-18 m	15-24 m	0.1-0.6 m high; gravel and large rock composition; little erosion.	Fast, run-riffle. Flow estimate: 3.5 m^3/s. Depth: 0.2-1.2 m	Generally coarse gravel; not suitable for spawning at crossing point.
Prudhomme Creek (Inlet to East End, Prudhomme Lake)	10-12 N	Dec. 1	Lower 2 km.	6-9 m	9-12 m	0.6-1.5 m high; heavy soil layer on gravel; no active erosion.	Lower 500 m is slow, meandering; upper 1.5 km has faster flow with pool: riffle alternation. Flow estimate: 1.5 m^3/s.	Very stable stream with good rearing and spawning habitat.
Lachmach River	20-24 N	Nov. 30	At crossing point (km 23.7 N) and areas above and below.	5-7 m	7-9 m	0.6-1.7 m high; gravel and bedrock base; little erosion.	Medium gradient from pipeline crossing to falls (km 22 N); with fast, turbulent flow Lower gradient with pool: riffle sequence below falls. Flow estimate: 1.4 m^3/s.	1 live coho adult and 27 redds observed from crossing to lake and 1 redd immediately below crossing point. Good spawning area in vicinity of crossing.
Diana Creek		Oct. 11	300 m above highway	12 m	12 m	Low grassy banks; no active erosion.	Smooth flowing; even gradient (surface velocity 0.4 m/s.) Flow estimate: 2.5 m^3/s. Depth: 0.5-1 m.	Clay and sand substrate. No spawning gravel evident at crossing, but good rearing habitat. Approaches to stream are gradual in slope.
Gamble Creek (Inlet to Harrison Lake)	15.8 S	Oct. 11	At and below crossing point for 400 m.	4 m	4 m	Low, grassy banks; no active erosion.	Even flowing; surface velocity less than 0.2 m/s.	Mud and organic debris substrate. Beaver dam blocks fish access 400 m below crossing. Low lying land.
McNeil (Green) River	19-20 S	Oct. 11	At crossing points (3).	20 m (at ½ tide)		Mud, grassy banks. Gradual slope with little erosion.	Tidal and smooth flowing.	No spawning area in this section; possibly some rearing. Flat approaches to stream.
Aberdeen Creek	24.3 S	Nov. 12	Below crossing point.	2.5 m	4-6 m (at flood tide)	0.5-2.5 m high; mud and clay; no active erosion.	Fast and turbulent to intertidal area. Flow estimate: 0.6 m^3/s. Depth: 0.2-1 m.	Scattered gravel suitable for spawning. Eel grass in intertidal zone. Length accessible to salmon: 250 m intertidal + 150 m to falls.

TABLE D-1 - (Cont'd)

Stream	Route Kilometre Post	Date	Area Inspected	Approx. Width		Bank Character	Flow Character and Volume	Comments
				Wetted	Total			
Inver Creek	28.2 S	Nov. 12	Below crossing point.	1-1.5 m	4-6 m	0.6-2.5 m high; gravel with soil covering; no active erosion.	Low gradient, tidal in lower 800 m and steep, fast-flowing in upper 800 m to falls. Flow estimate: 0.8 m^3/s.	Patches of suitable spawning gravel in intertidal zone, but no redds observed.
Antigonish Creek	29.2 S	Nov. 12	Above and below crossing point (1.2 km of stream).	2-3 m (non-tidal) 2-25 m (tidal)	3-5 m 12-60 m	Large boulders and bedrock banks above intertidal, with clay banks in intertidal area. Little erosion.	Very fast and turbulent above intertidal zone. Flow estimate: 1 m^3/s.	No apparent spawning potential. Transmission line crossing would be in intertidal zone.
Khyex River	33.1-33.4	Oct. 11	At crossing point.	150 m	150 m	Not observed; inspected at high tide.	Relatively slow, smooth flowing, tidal section.	No spawning potential. Possibly rearing along the edges. River is a salmonid migration route at the crossing point.
Scotia River	46.9 S	Oct. 10	At and above crossing point for 2 km.	35 m	35 m	0.6-1 m high; clay and silt composition; no active erosion.	Slow, smooth flowing and tidal in this section.	Same conditions as Khyex R. crossing.
Khtada River	49.6	Aug. 20	At crossing point and upstream for 1.5 km (from air by helicopter).	100 m (approx.)	100 m	Rocky and steep on east bank; grassy and low on west bank.	Smooth flowing; tidal	Crossing would be in tidal waters at mouth, below falls which is impassable to salmonids.
Kwinitsa Creek		Dec. 1	Lower 1.5 km of stream	7-12 m	12-60 m (at flood tide)	0.6-2 m high; clay composition	Fast flowing; medium gradient. Few side channels; appears relatively stable. Lower 500 m is tidal.	6 redds with no fish observed just above tidewater. Some spawning gravel observed above tidal influence. Crossing would likely be in tidal section.
Feak Creek	57.5	Sept. 16	Lower 1.2 km of accessible stream.					Not included in physical survey. Transmission line would cross at mouth, below spawning area.
Alder Creek		Oct. 10	First 600 m upstream from mouth.	15 m	18 m	0.6-1 m high; gravel and sand; little erosion.	Moderate to high gradient; primarily rapid and riffle. Flow estimate: 5 m^3/s.	Little spawning gravel noted. Predominantly a cobble and boulder bottom.

TABLE D-1 - (Cont'd)

Stream	Route Kilometre Post	Date	Area Inspected	Approx. Width		Bank Character	Flow Character and Volume	Comments
				Wetted	Total			
Arga Creek	69.6 S	Sept. 15	Lower 1 km of accessible stream.					Not included in physical survey. Has good spawning habitat and appears stable in area at proposed crossing.
Kasiks River	69.5 N	Sept. 11	At highway crossing and upstream for 10 km by helicopter.	70 m	70 m	Protected with rip-rap at mouth.	Smooth flowing and slow.	Sand bottom. Transmission line route is 6.5 km below salmon spawning area. Slough to east of river is a reported salmon rearing area.
Exchamsiks River	77.7	Aug. 22	At highway bridge.	60-70 m	60-70 m	2-4 m high; sand on east and mainly rock on west bank.	Smooth flowing and slow (less than 0.4 m/s).	Glacial stream with low lying approaches at mouth. No spawning evident at mouth. High sand content in gravel.
Gitnadoix River		Oct. 9	At river mouth (site of present transmission line crossing).	45 m	45 m	0.6 m high; sand and gravel.	Smooth flowing.	Below any spawning area. Approaches to river are a steep rocky bank on west and low river island on east.
Exstew Slough		Aug. 22	Mouth of Andesite Ck. to confluence of Slough with Skeena R. (500 m)	20 m	25 m		Mainly steep riffles and runs.	Abundant spawning gravel in this section.
Exstew River	95.5 N	Aug. 22	Near proposed crossing point just above railway bridge.	70 m	70 m	1-1.7 m high; sand and mud; no erosion evident.	Smooth flowing with surface velocity of 0.3-0.5 m/s.	Glacial tint. River constricted in this area by existing bridge abutments. Approaches are gradual.
Esker Slough	99.4 N	Aug. 22	Just above railway bridge, near proposed crossing point.	40 m	40 m		Slow-moving slough in this area. Flow estimate through 2 culverts: 0.1 m^3/s.	Appears to be good rearing area, but no spawning area evident.
Shames River and Slough	107.5 N	Aug. 22	Area of proposed crossing downstream to mouth of Slough.	18 m (at crossing)	50 m	Gravel banks 1.2 m high; considerable erosion evident at crossing point.	Primarily rapids with infrequent pools in crossing area. Two main channels.	Unstable stream channel comprised mainly of boulders to 0.5 m diameter in vicinity of crossing. Stream channelized in lower 500 m to Slough, to protect highway and railway bridges. Virtually all suitable spawning area is now situated in Slough near the mouth.

TABLE D-1 - (Cont'd)

Stream	Route Kilometre Post	Date	Area Inspected	Approx. Width		Bank Character	Flow Character and Volume	Comments
				Wetted	Total			
Dasque Creek	105 S	Aug. 21	Near stream mouth (lower 300 m)	8 m	80 m	2.5-3 m high; gravel and sand banks; extensively eroded.	Rapids and chutes. Flow estimate: 3 m³/s.	Very unstable stream. No suitable area for spawning in lower reaches of this stream. Approaches gentle on east but rock face on west.
Middle Creek	106.7 S	Aug. 21	Area of proposed crossing downstream to 400 m above mouth.	10 m (2 channels at crossing)	60 m	Gravel banks 0.6 m high; extensively eroded at crossing.	Rapids and chutes with infrequent pools. Flow estimate: 2 m³/s at crossing.	An unstable, high gradient stream with only pockets of gravel suitable for spawning. Becomes more suitable as gradient lessens in lower reaches. Flat approaches to stream.
Whitebottom Creek	108.6 S	Aug. 21	Area of proposed crossing	4 m	10 m	Gravel banks 1.5-2 m high and heavily eroded.	Rapids and chutes over boulder bottom. Flow estimate: 0.15 m³/s.	Another high gradient stream and no suitable spawning gravel in vicinity of proposed crossing. Flat approaches to stream.
Lakelse River	117.8	Aug. 21	At proposed crossing point.	25 m	35 m	1.5 m high banks of sand and gravel with moderate erosion.	Flat reach with pool: riffle alternation. Flow estimate: 10 m³/s.	Very flat approaches to crossing. Extensive bank protection (rip-rap and sheet pilings) has been installed to protect existing west bank transmission tower, now located within 10 m of river. An estimated 10 300 m² of spawning area was observed between crossing point and the road bridge, 2 km downstream.
Almyn Creek	123 125	Aug. 21	At road bridge crossing	3-4 m	3-4 m	Gravel banks 0.5 m high, with little evidence of erosion.	Smooth flowing with periodic riffles. Flow estimate: 0.3 m³/s.	Cobble and gravel bottom. Heavy vegetation cover. Good juvenile rearing habitat.

TABLE D-2

SALMONID FISH UTILIZATION OF WATERBODIES WITHIN THE STUDY AREA FOR THE PROPOSED SKEENA-RUPERT TRANSMISSION LINE

			Salmon Species and Escapements*1					Trout (Salmo) Species					
Waterbody	Route Km Post		Pink	Chum	Sockeye	Chinook	Coho	Cutthroat	Steelhead	Rainbow	Unidentified	Dolly Varden Char	Comments
Kloiya River	4.1	Mean Range	1030 0-5000	185 0-1000	M	455 100-2000	450 50-2000	SR*8	SR*3			SR*8	Most spawning occurs in 2 km downstream proposed crossing point.*1
Taylor Lake	5.3 N				R		R						
Prudhomme Lake	7-9 N				R		M	R*8	R*8			R*8	
Prudhomme Creek	10-13 N	Mean Range			1775 250-5000	20 10-50	395 50-2500	SR*8					East inlet to Prudhomme Lake. Spawning and rearing in 3 km paralleled by route. Escapement estimates, combined with Diana Creek in DFO files, were estimated as a proportion of total to Diana-Prudhomme system.*6
Unnamed Creek Flowing to Work Channel	17.2 N						P*2	P*2					
Lachmach River	19-26 N	Mean Range	3300 100-15 000	1060 400-3000			470 50-2000		SR*3				Route parallels spawning and rearing area for entire length of river system.
Diana Creek	6.2 S	Mean Range			1775 250-5000	175 50-500	1180 150-7500	SR*8	SR*8			SR*8	Most salmon spawning occurs upstream of the proposed crossing point.*6
Toona Lake	10.7 S							P*8					
Diana-Rainbow Lake	13.7 S							P*8				P*7	
Gamble Creek	15.7 S 17.8 S												No inventory data available.
Harrison Lake	16.5 S											P*8	
McNeil River (Green River)	18.9 S 19.4 S 19.8 S		S*7				SR*7	SR*8	SR*8			SR*8	
Stapledon Creek	22 S							R*7				R*7	
Aberdeen Creek	24.3 S						R*7						

Legend: S = Spawning R = Rearing M = Migration P = Present (Undifferentiated)

ESS-20

TABLE D-2 - (Cont'd)

			Salmon Species and Escapements*[1]					Trout (Salmo) Species					
Waterbody	Route Km Post		Pink	Chum	Sockeye	Chinook	Coho	Cutthroat	Steelhead	Rainbow	Unidentified	Dolly Varden Char	Comments
Inver Creek	28.2 S												Limited survey data indicates no spawning or rearing.*7
Antigonish Creek	29.2 S						R*7						
Marigonish Creek	29.8 S												Limited survey data indicates no spawning or rearing in either Marigonish or Ekumsekum Creek.*7
Ekumsekum Creek	31												
Khyex River	33.1- 33.4	Mean Range	7200 300-60 000	1145 50-10 000		120 1-1000	1850 200-10 000	P*3	SR*3			P*3	River is tidal and a salmonid migration route at crossing point. Downstream end of spawning area is 6.5 km above crossing point.
Scotia River River.	46.9 S	Mean Range	9540 1-100 000				SR*4						River is tidal at crossing point. Downstream end of spawning area is 4 km above crossing point.
Khtada River	49.6									P*3		P*3	A falls, impassable to anadromous fish, is situated at upper limit of tidal influence, 400 m above crossing point.
Kwinitsa	-	Mean Range	460 1-1200				40 1-100		P*3				Lower 1.5 km is tidal.
Feak Creek	57.5		S*9				SR*4						All spawning occurs upstream of proposed crossing point. Impassable falls is situated 2 km above mouth.
Alder Creek	-		S*4				R*9				R*9	R*4	
Arga Creek	69.6 S		S*4				R*9				R*9		1 km of stream accessible to anadromous fish.*9
Kasiks River	69.5 N	Mean Range	870 100-2000	275 1-1500	P	225 0-500	1770 300-10 000	R*2				R*2	Downstream limit of salmon spawning is 6.5 km above river mouth.*9
Exchamsiks River	77.7	Mean Range	780 0-10 000	120 0-300	P	90 1-300	840 0-5000	R*2				R*2	Downstream limit of salmon spawning is 4 km above river mouth*9, and majority of spawning occurs 16 km or more above mouth.*4

Legend: S = Spawning R = Rearing M = Migration P = Present (Undifferentiated)

E55-20

TABLE D-2 - (Cont'd)

			Salmon Species and Escapements*[1]					Trout (Salmo) Species					
Waterbody	**Route Km Post**		**Pink**	**Chum**	**Sockeye**	**Chinook**	**Coho**	**Cutthroat**	**Steelhead**	**Rainbow**	**Unidentified**	**Dolly Varden Char**	**Comments**
Gitnadoix River	-	Mean Range	1865 0-10 000	840 100-5000	M	285 1-1000	7060 300-50 000	SR*2,3	SR*2,3			SR*2,3	Downstream limit of salmon spawning is 2 km above existing transmission line crossing.*9 Sockeye migrate through study area to spawn and rear in Alastair Lake.*1
Exstew Slough	-	Mean Range	6200 0-100 000	125 0-500									
Breccia Creek	-						R*4	R*4				R*4	
Exstew River	95.5 N	Mean Range	400 1-2000	5	P	115 1-300	1310 50-5000	R*2				R*2	Downstream limit of salmon spawning is 9 km above the river mouth.*4
Esker Slough	99.4 N			S*4	SR*4		SR*4						Proposed transmission line crossing is near mouth of slough, below spawning areas.*4
Shames River and Slough	107.5 N	Mean Range	1400 25-5000	150 1-500		R*2	SR*4	R*2				R*2	Pink and chum salmon spawning occurs mainly near the stream mouth, downstream of the proposed transmission line crossing point.*9
Dasque Creek	105 S	105 S					SR*4	R*2				R*2	Coho salmon spawn in upper reaches of this stream.*4
Middle Creek	106.7 S		S*9	S*9			SR*4				R*9		Pink and chum salmon spawning is concentrated near stream mouth.*9
Whitebottom Creek	108.6							R*5					Whitebottom Creek enters a swamp area which appears to drain both directly to Skeena River and also to Middle Creek tributary with chum spawning.*9
Lakelse River	117.8	Mean Range	365 900 50 000- 1 225 000	380 0-5000	M	190 1-500	18 500 500-50 000	R*5	SR*3			R*5	Most (90-95%) of pink spawning and all spawning by chinook, coho and steelhead occurs upstream of proposed crossing point.*4 Sockeye migrate through study area to spawn in tributaries to Lakelse Lake.*1
Alwyn Creek	123-125	Mean Range	S*4				31 1-100						
Skeena River Mainstem	65-114	Mean Range	81 400 5000-500 000	1150 500-2000		1380 100-2000							Pink and chinook escapement estimates include a portion spawning upstream of the study area, judged to be relatively small for pinks and relatively large in case of chinook.*4

Legend: S = Spawning R = Rearing M = Migration P = Present (Undifferentiated)

TABLE D-2 - (Cont'd)

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*1 From Dept. of Fisheries & Oceans (DFO), Annual Reports of Salmon Streams and Spawning Grounds, 1950-1979 or shorter periods where records are incomplete. Other information sources are indicated where applicable.

*2 Resource Analysis Branch, B.C. Ministry of the Environment (MOE), unpublished stream inventory data.

*3 Fish & Wildlife Branch, MOE, Steelhead Harvest Analyses, 1973-1978, and unpublished data on file in Smithers.

*4 J. Hipp, Fishery Officer, DFO, Terrace.

*5 D. Crack, Conservation Officer, MOE, Terrace.

*6 T. Panko, Fishery Officer, DFO, Prince Rupert.

*7 S. Kriegl, Fishery Officer, DFO, Prince Rupert.

*8 R. Escott, Conservation Officer, MOE, Prince Rupert.

*9 D. B. Lister & Associates Ltd.

Legend: S = Spawning R = Rearing M = Migration P = Present (Undifferentiated)

5. Contacts with federal Department of Fisheries and Oceans and provincial Ministry of the Environment personnel.

6. Field observations by D.B. Lister and Associates Ltd. personnel and J. Culp of J & S Outdoor Ventures Ltd. during August to December, 1980.

Sources of data presented in Table D-2 are indicated in footnotes.

D.5 SALMON SPAWNING DISTRIBUTION

Initial review of the information on salmon spawning distribution in relation to the proposed routes indicated a lack of data on the Skeena River mainstem. Survey effort was, therefore, concentrated on documentation of mainstem spawning areas. Department of Fisheries and Oceans personnel provided information on spawning distribution in other streams of the study area, as well as supplementary information on mainstem spawning areas.

Visual observations of salmon spawning in the Skeena River were obtained by boat surveys during 9 to 16 September. This period included the later stages of pink salmon spawning and appeared to coincide with the peak period of chum salmon spawning. The survey area extended from the Lakelse River mouth to the downstream limits of salmon spawning in the vicinity of Selma Island. The following observations were recorded for each spawning area: numbers of live and dead salmon by species (and sex where possible); presence of salmon surfacing in the river; number of fresh salmon redds or spawning nests; and location of the area on 1:50 000 scale topographic maps. Recent (1979) aerial photographs of the study area (1:20 000 scale) were also utilized to plot spawning areas on the 1:50 000 scale maps.

Pink and chum salmon were the only species observed spawning within the study area. One chinook salmon carcass was observed. The depth of salmon spawning, particularly pinks, combined with water turbidity precludes direct visual observation of spawning in some areas of the Skeena River. In such cases it was concluded that spawning had occurred in a particular area when two of the following three conditions were met:

1. fresh redds were observed;
2. persistent salmon surface activity was noted; and
3. carcasses of female salmon were observed in proximity to (1) or (2).

The methods employed would tend to underestimate the number of spawning areas. The relatively small pink salmon escapement in 1980 probably did not utilize as many stream areas as would be the case in years of average or above-average escapement. Under different river flow conditions additional spawning areas would be utilized. Had the survey period been longer, spawning might have been observed in other areas. This applies especially to pink salmon, which were in the late stages of spawning at the time of the survey.

Salmon spawning observations made are summarized in Table D-3 and the accompanying site location map (Figs. D-1.1 to D-1.4). The data indicated that pink salmon generally spawned in strongly flowing channels of the main river, whereas chum salmon tended to spawn in blind, cut-off side channels fed principally by groundwater.

D.6 EVALUATION OF ROUTE ALTERNATIVES

Background data utilized to compare route alternatives with respect to potential fishery resource impacts are presented in Table D-4. The criteria used in the evaluation of alternatives included: (1) numbers of salmonid streams crossed or paralleled by the route; (2) length of salmonid stream paralleled; (3) average salmon escapement in streams crossed or paralleled by the route; and (4) the number of known salmonid spawning or rearing areas in proximity to the route.

On this basis the following conclusions were reached on route preference from a fishery resource standpoint:

Route Alternatives Compared	Preferred Route
1. (a) Rainbow-Tyee	Rainbow-Tyee
(b) Prudhomme, Channel and Lachmach	
(c) Prudhomme, Minerva and Lachmach	(Route (c) is least preferred)
2. Telegraph vs Ayton	No preference
3. Mt. Bucey vs Kasiks	Slight preference for Mt. Bucey alternative.
4. Exchamsiks Crescent vs Exchamsiks Ridge	Exchamsiks Ridge
5. (a) Exstew, Exstew East, Shames North and Klakelse Crossing	Preferred
(b) Exstew, Exstew East, Shames South and Klakelse Crossing	Second preference
(c) Exstew, Crossing and Dasque	Third preference
(d) Hudson-Dasque	Least desirable

TABLE D-3

SALMON SPAWNING AREAS OBSERVED IN SKEENA RIVER MAINSTEM DURING THE FALL OF 1980
SITE LOCATIONS ARE IDENTIFIED ON THE ACCOMPANYING MAP (FIG. D-1)

		No. of Salmon Observed					
		Pink Salmon		Chum Salmon			
Site No.	Date	Live	Dead	Live	Dead	Other Fish Observations	Site Characteristics
1	Sept. 9		1 M		2 M	8-10 redds; salmon surfacing.	Side channel of main river.
2	Sept. 9	5		50	4 M	1 live coho.	Groundwater-fed side channel; water temperature 11°C vs 9°C in Skeena at 1330 hr.
3	Sept. 9	4	5		1	Large number of redds observed. Main spawning took place earlier.	Mainstem bar; 25-100 mm gravel in 30 cm of water.
4	Aug. 22	4		32		Spawning appeared to have just started.	Lower Shames River near confluence with Skeena.
	Sept. 9	9		20			1 grizzly bear was observed fishing in this area.
5	Sept. 9	7		38	2	Pinks and chums spawning near Middle Creek mouth and chums spawning also in right bank tributary.	Tributary (1.5 m^3/s) drains swamp area and appears much more stable than Middle Creek (0.8 m^3/s).
6	Sept. 9		1 M	35			Groundwater-fed side channel with little flow (est. 0.01 m^3/s) over gravel bottom.
7	Sept. 10		3		1	Redds noted at water's edge and on bar, above present water level. 1 chinook carcass observed.	Mainstem bar. Fine, 25-75 mm gravel predominates.
8	Sept. 10			100	6	Spawning occurred in 1.5-2 m of water.	Blind, groundwater-fed channel with little current. Water very clear.
9	Sept. 10		1 M			Steady surfacing of pink salmon, some partially-spawned, was observed in 1 m of water, 6 m or more off shore.	Mainstem bar spawning area. Gravel size: 20-125 mm.
10	Sept. 10			200+		Chum spawning against banks, mainly on south side.	Large side channel off the Skeena mainstem.
11	Sept. 10	1 M	2 M			Redds observed along edge of bar.	Medium-sized gravel of 25-100 mm diameter.
12	Sept. 10			5	1	Redds located in slow pools against bank.	Blind, groundwater-fed side channel.
13	Sept. 11		17 F			Pinks surfacing on north side of channel. 6 redds observed in areas on both sides of channel.	Water depth 30-60 cm on south side and 90 cm on north side of channel.
14	Sept. 13	1 F	2 M	1 M	1 M	30 redds observed below wetted perimeter and another 15 redds exposed on bar.	Spawning area on south bank of second channel below Exstew River.
15	Sept. 10		3 M 2 F			4-6 new redds plus redds from previous years, apparently pink salmon. Minor spawning area.	Relatively stable channel.

Legend: M = Male F = Female

TABLE D-3 - (Cont'd)

Site No.	Date	No. of Salmon Observed				Other Fish Observations	Site Characteristics
		Pink Salmon		Chum Salmon			
		Live	Dead	Live	Dead		
16	Sept. 11	2 F	3			20-30 redds over a length of 7-800 m along bar on south side of channel below proposed transmission line crossing.	30-60 cm water depth.
17	Sept. 11	10				Redds observed along 200 m length of bar.	30-60 cm depth; along north side of channel.
18	Aug. 22	1		8		Redds situated below mouth of Andesite Creek for 300 m distance to confluence of side channel with larger channel.	Side channel of Skeena mainstem.
19	Sept. 10			50+	12		Blind, groundwater-fed channel.
20	Sept. 13		3 F			1 redd sited.	Gravel of 40-60 mm size with some silt and compaction.
21	Sept. 13	3 F	2 M	1 F			Coarse gravel. Main river bar.
22	Sept. 14				1 M	5 large redds (probably chum) observed.	This side channel receives Skeena River surface water but is protected by a log jam at the upper end.
23	Sept. 14		2 M			1 redd observed.	Most of gravel was silty and compacted.
24	Sept. 14		1 M			40+ pink salmon redds below wetted perimeter and 25+ now above water level.	Stable, side channel with surface water but protected by log jam at upper end. Appears to be a very productive spawning area.
25	Sept. 14			20+	8	Turbid water did not permit accurate enumeration. Chums appeared to be spawning near groundwater seepage.	Side channel supplied by Skeena River water.
26	Sept. 14	1 M	2 M		1 F	12 redds within wetted perimeter and 12 redds above water level.	Protected side channel of main Skeena River. Water temperature 11°C. Gravel size 30-60 mm.
27	Sept. 14		1 M		1 M	25+ redds observed within wetter perimeter.	Mainstem Skeena bar with 30-60 mm gravel.
28	Sept. 14		2 M 1 F			17 pink salmon redds observed below wetted perimeter.	Stable bar of main river, with 30-60 mm gravel.
29	Sept. 14					Adult coho observed below mouths of 2 creeks; coho juveniles also observed in creeks.	Very little spawning or rearing area in either creek.
30	Sept. 14		5 M 4 F		2 M 2 F	2 redds observed near lower end of bar.	Main river channel; 30-60 cm diameter gravel.
31	Sept. 14	1 M	1 M 1 F			2 redds observed.	Similar to Site 30.

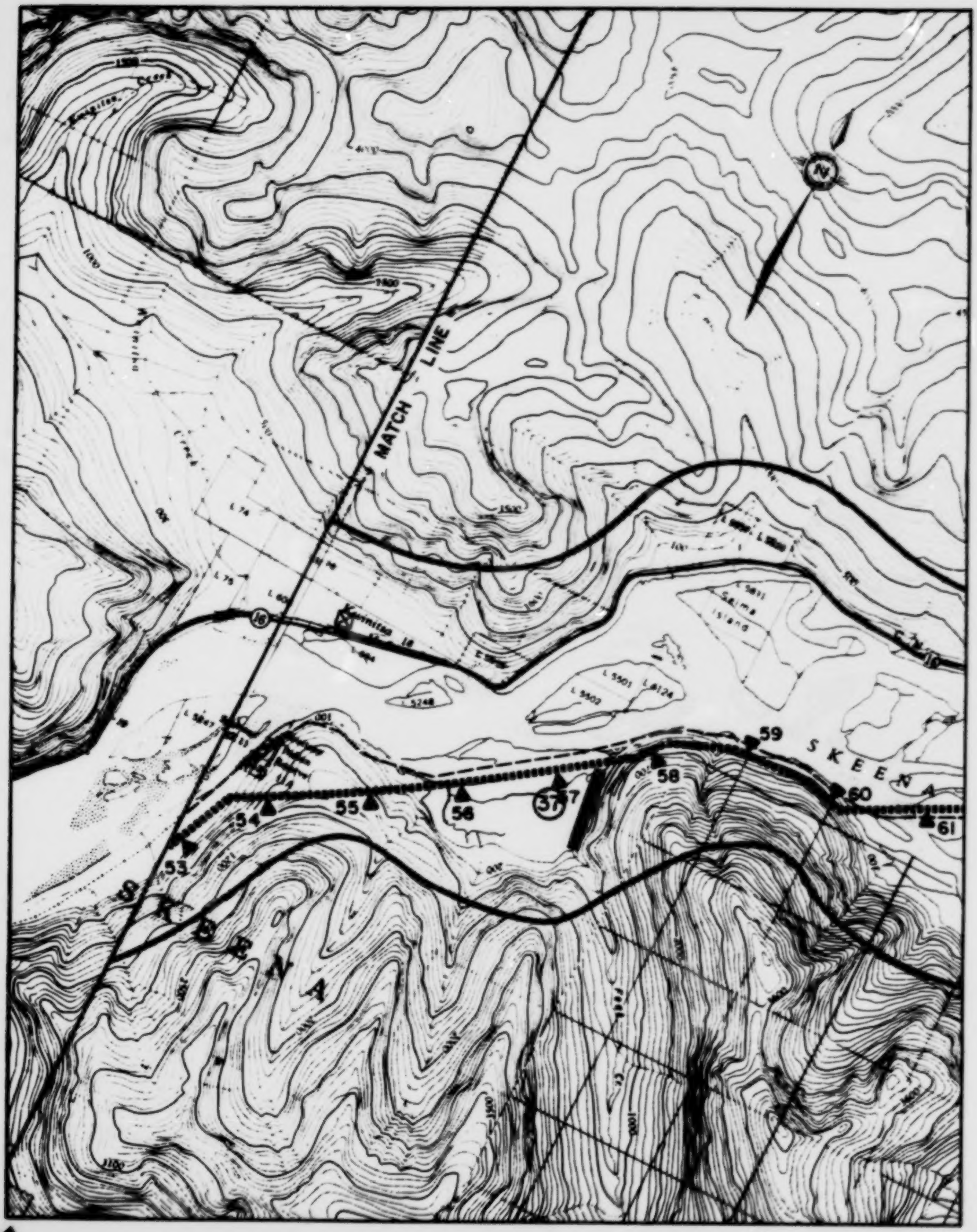
Legend: M = Male F = Female

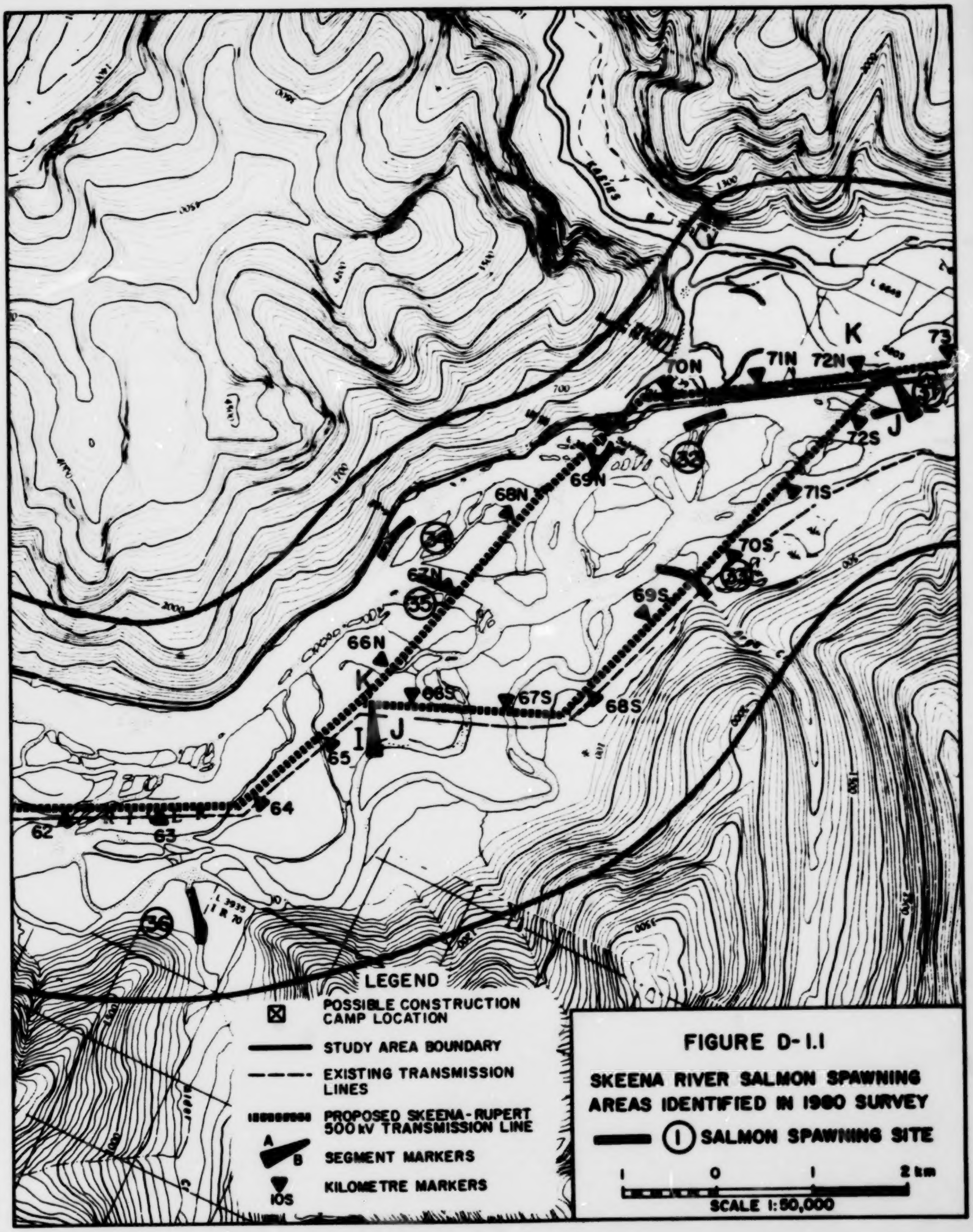
TABLE D-3 - (Cont'd)

		No. of Salmon Observed					
		Pink Salmon		Chum Salmon			
Site No.	Date	Live	Dead	Live	Dead	Other Fish Observations	Site Characteristics
32	Sept. 14		1			17 redds observed within wetted perimeter of river on lower 100 m of bar.	Some silt noted.
33 (Arga Ck.)	Sept. 15					No redds or adult salmon observed. Coho and trout underyearlings were noted.	Relatively stable stream with good spawning gravel. Water temperature 8°C.
34	Sept. 16		5 M 2 F			58 pink salmon redds above water level and 10 redds within wetted perimeter.	Bar of good spawning gravel with some silt evident. Relatively stable in appearance.
35	Sept. 16		6 M 5 F			17 redds observed, all above existing water level.	Well protected bar on main river channel.
36 (Alder Ck.)	Sept. 16					No adult salmon or redds observed. Too early for coho spawning. Coho and trout underyearlings observed.	Fair spawning potential in lower 800 m of stream. Mainstem area from site 35 to Selma Island is relatively poor spawning area with high silt content in gravel.
37 (Feak Ck.)	Sept. 16	2				25+ pink or chum salmon redds.	A relatively stable stream with fair quantity of clean gravel.

Legend: M = Male F = Female

FIGURES D-1.1 to D-1.4

MATCH LINE
N
1500
Creek
L 74
L 75
L 60
16
Kwinitsa
16
L 5811
Selma
Island
16
L 5248
L 5501
L 6124
L 5502
L 5867
53
54
55
56
37
57
58
59
60
61
SKEENA
SKEENA
1100
1500
1000


K
73
70N
71N
72N
31
J
72S
32
69N
71S
68N
34
70S
33
67N
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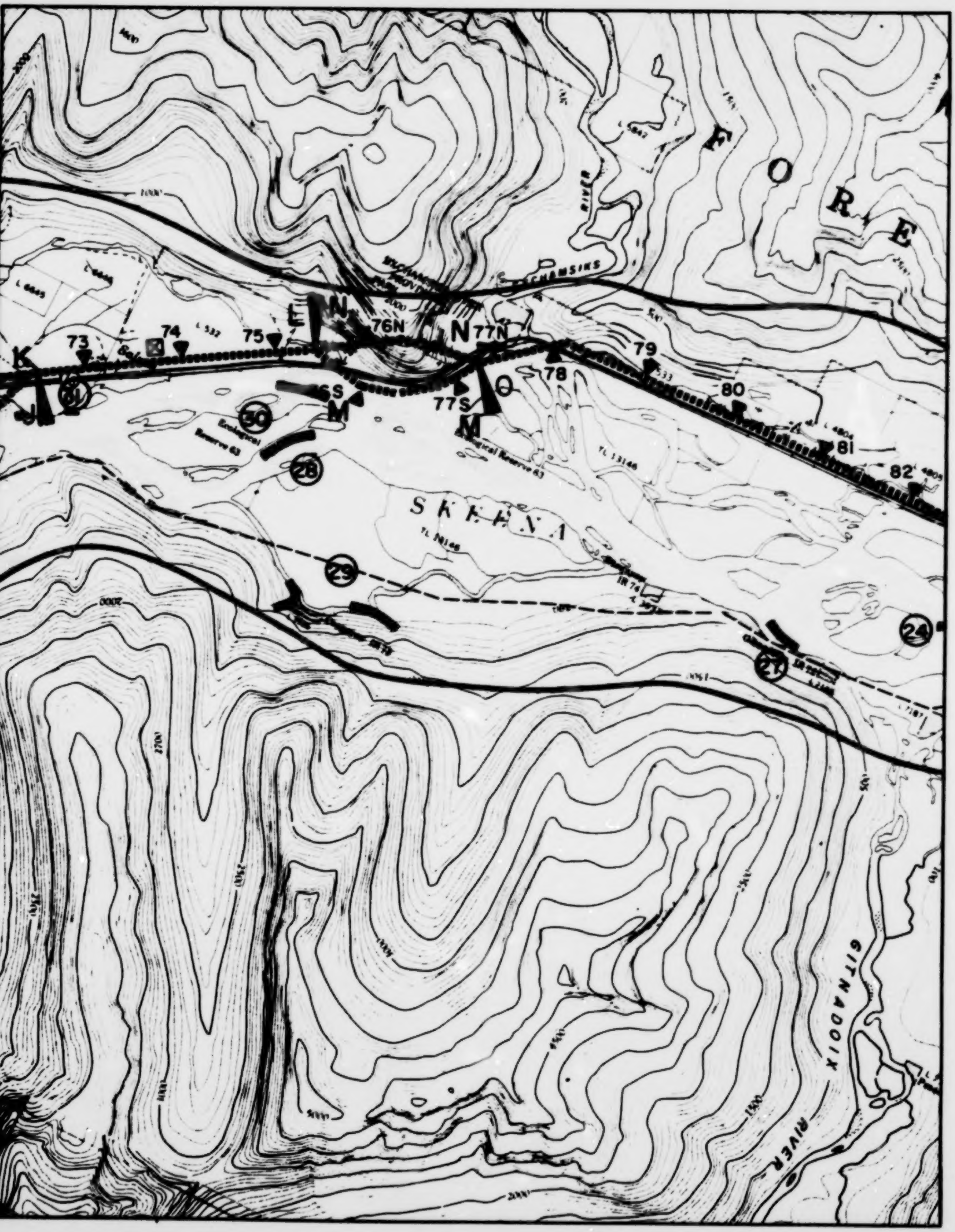
69S
66N
K
66S
67S
68S
I
J
65
64
62
63
36
L 3935
I R 70
L 6645
700
1700
2000
1300
1500
2500
LEGEND
☒ POSSIBLE CONSTRUCTION CAMP LOCATION
STUDY AREA BOUNDARY
EXISTING TRANSMISSION LINES
PROPOSED SKEENA-RUPERT 500 kV TRANSMISSION LINE
A
B
SEGMENT MARKERS
10S
KILOMETRE MARKERS
① SALMON SPAWNING SITE
1
0
1
2 km
SCALE 1:50,000

FIGURE D-1.1

SKEENA RIVER SALMON SPAWNING AREAS IDENTIFIED IN 1980 SURVEY


K
J
73
74
75
L
N
76N
N
77N
78
79
80
81
82
76S
M
77S
M
O
31
30
28
29
27
24
Ecological Reserve 63
Ecological Reserve 63
TCHAMSIKS
RIVER
F O R E
S K E E N A
GITNADOIX
RIVER

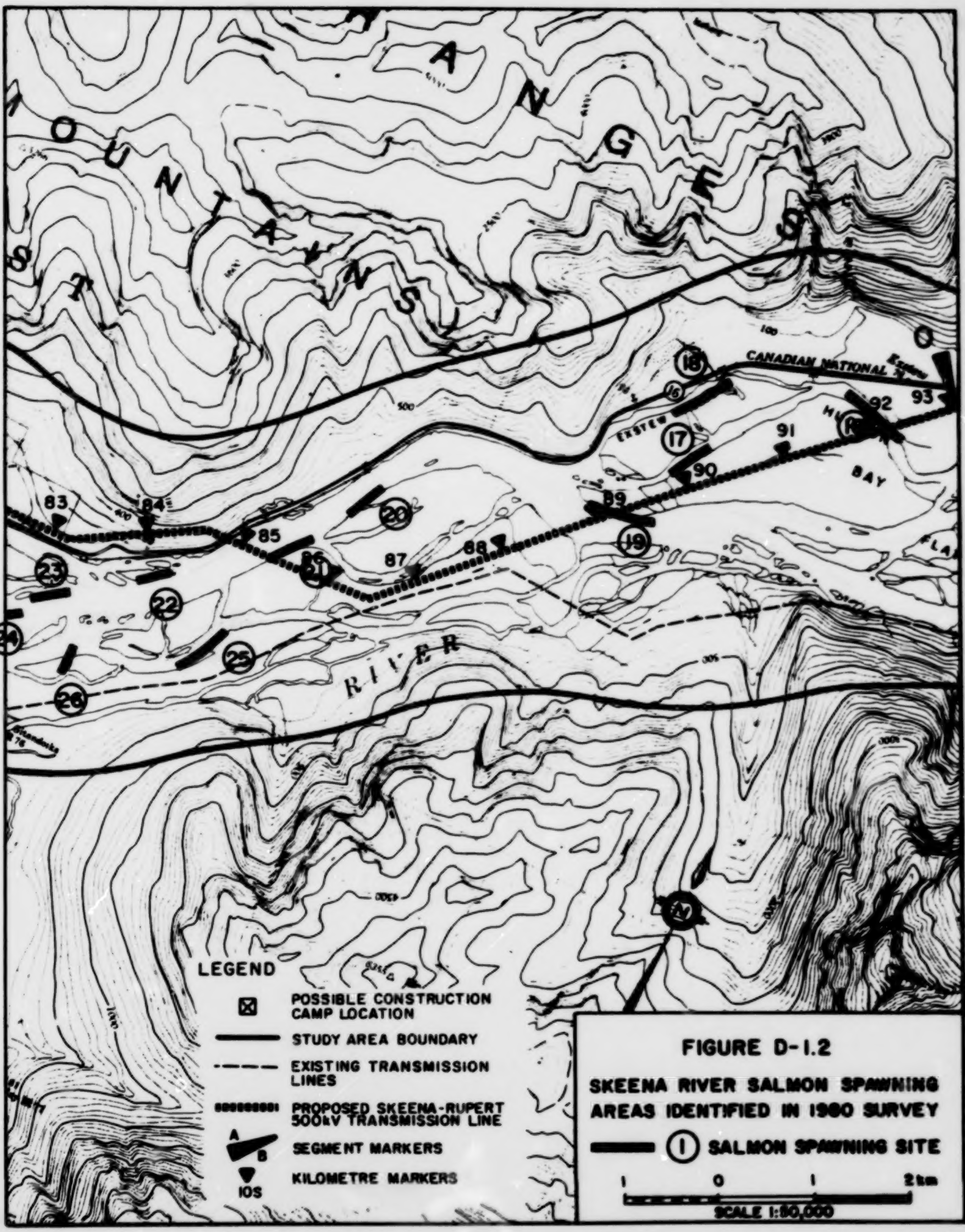
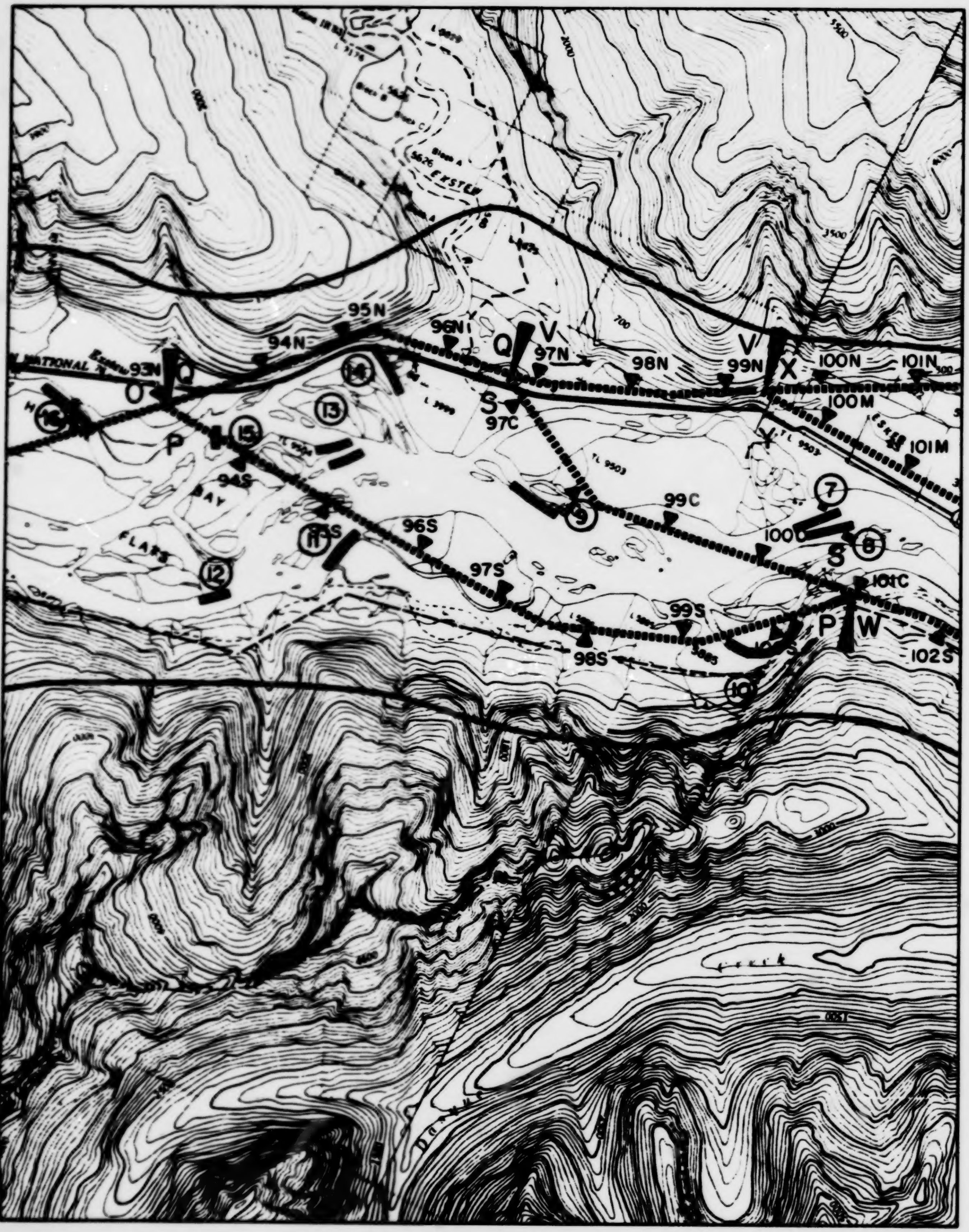


FIGURE D-1.2

SKEENA RIVER SALMON SPAWNING AREAS IDENTIFIED IN 1980 SURVEY

LEGEND
POSSIBLE CONSTRUCTION CAMP LOCATION
STUDY AREA BOUNDARY
EXISTING TRANSMISSION LINES
PROPOSED SKEENA-RUPERT 500kV TRANSMISSION LINE
SEGMENT MARKERS
A
B
KILOMETRE MARKERS
105
SALMON SPAWNING SITE
1
SCALE 1:50,000
1 0 1 2km
MOUNTAINS
RANGES
RIVER
CANADIAN NATIONAL
BAY
83
84
85
86
87
88
89
90
91
92
93
16
17
18
19
20
21
22
23
24
25
26
500
100



NATIONAL
93N
Q
O
94N
95N
14
13
16
H
P
15
94S
TL 9504
BAY
FLATS
11
95S
12
96N
Q
V
97N
S
97C
96S
97S
TL 9503
9
98N
99N
V
X
100N
101N
100M
101M
7
99C
100C
8
S
101C
99S
98S
P
W
102S
10
3500
5626
Creek

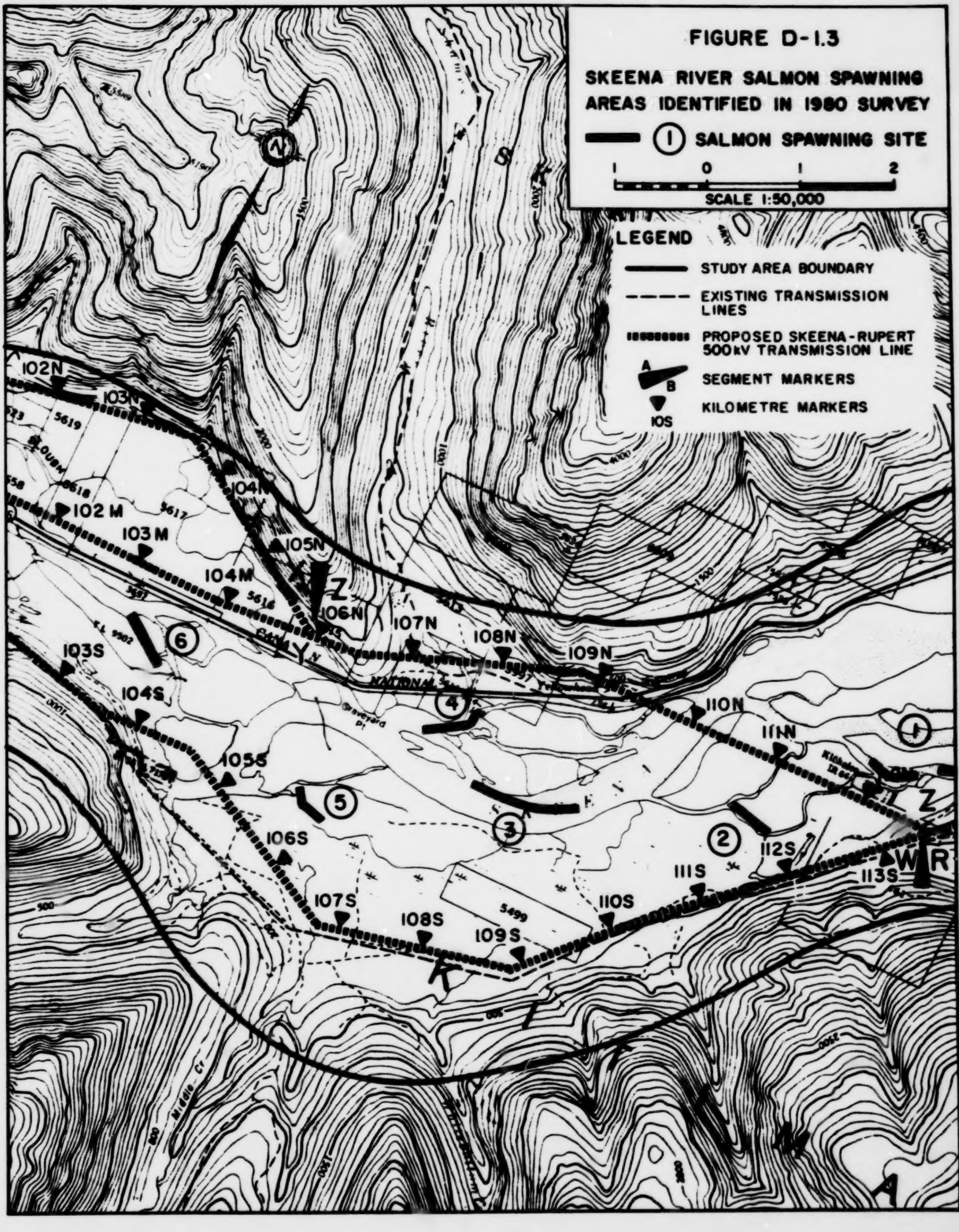
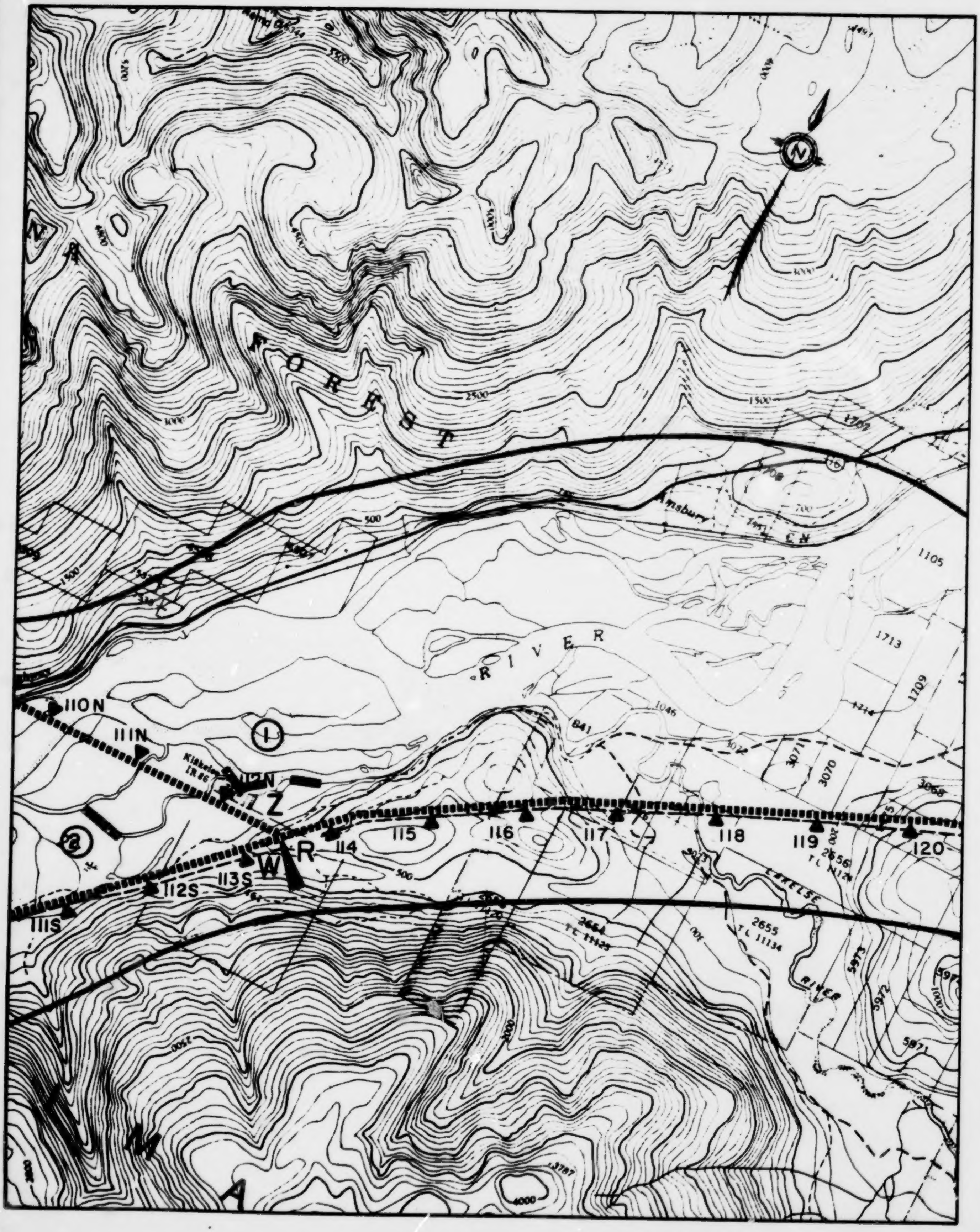


FIGURE D-1.3

SKEENA RIVER SALMON SPAWNING AREAS IDENTIFIED IN 1980 SURVEY

① SALMON SPAWNING SITE
1 0 1 2
SCALE 1:50,000
LEGEND
STUDY AREA BOUNDARY
EXISTING TRANSMISSION LINES
PROPOSED SKEENA-RUPERT 500 kV TRANSMISSION LINE
A B SEGMENT MARKERS
10S KILOMETRE MARKERS
102N
103N
104N
105N
106N
107N
108N
109N
110N
111N
102 M
103 M
104 M
103S
104S
105S
106S
107S
108S
109S
110S
111S
112S
113S
①
②
③
④
⑤
⑥
Z
Y
Z
W
R
K
A
SLOUGH
Graveyard Pt
NATIONAL
Middle Cr
5619
5618
5617
5616
5499


FOREST
RIVER
Amsbury
110N
111N
112N
Z
W
R
111S
112S
113S
114
115
116
117
118
119
120
2500
1500
1000
500
1105
1713
1709
1046
841
3071
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3787
4000
RIVER
A
M
A

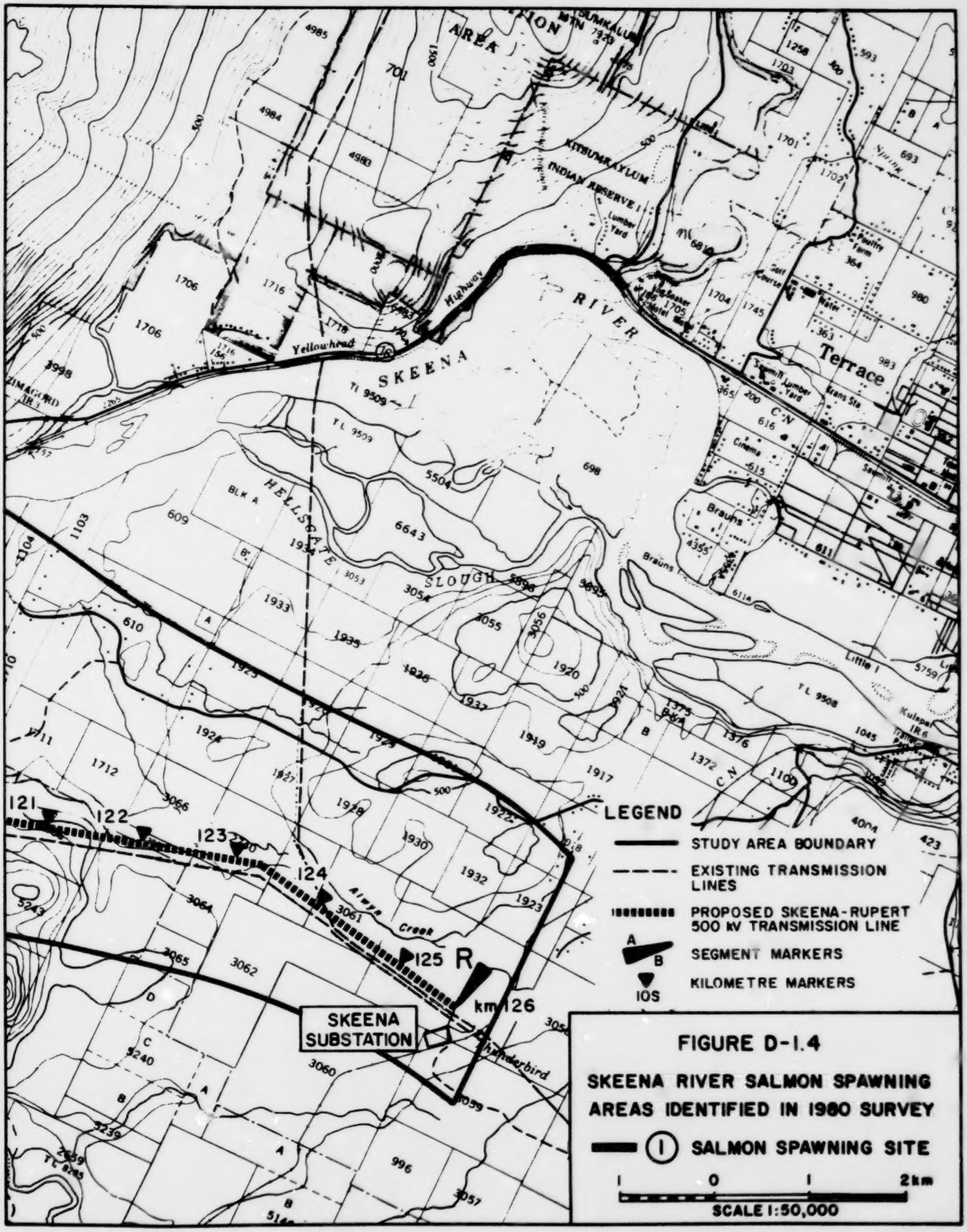
SKEENA RIVER
Terrace
HELLSGATE SLOUGH
KITSUMKAYLUM INDIAN RESERVE I
Yellowhead Highway
16
CN
Alwyn Creek
Thunderbird
SKEENA SUBSTATION
121
122
123
124
125
km 126
R
LEGEND
STUDY AREA BOUNDARY
EXISTING TRANSMISSION LINES
PROPOSED SKEENA-RUPERT 500 kV TRANSMISSION LINE
A B SEGMENT MARKERS
105 KILOMETRE MARKERS
1 SALMON SPAWNING SITE
1 0 1 2km
SCALE 1:50,000

FIGURE D-1.4

SKEENA RIVER SALMON SPAWNING AREAS IDENTIFIED IN 1980 SURVEY

TABLE D-4

COMPARISON OF SKEENA-RUPERT TRANSMISSION LINE ROUTE ALTERNATIVES WITH RESPECT TO POTENTIAL FOR FISHERY RESOURCE IMPACT

Route Alternatives Compared (Listed by Route Segments)	Salmonid Streams and Skeena Mainstem Channels Crossed by Route		Salmonid Spawning Streams Paralleled by Route		Average Salmon Escapement Within 2 km Downstream of Stream Crossings and 0.5 km of Paralleling Streams	No. of Known Salmonid Spawning or Rearing Areas 2 km Downstream of or 0.5 km Upstream of Route, and Adjacent to the Route (within 0.5 km)	Preferred Route From Fishery Resource Standpoint
	Streams	Total No.	Streams	Total Length (km)			
1. Prudhomme (C), Channel (T), Lachmach (E)	Prudhomme Ck. Unnamed Ck. (tributary to Work Channel) Lachmach R.	3	Prudhomme Ck. Lachmach R. Marigonish Ck.	26	7020 Prudhomme Ck. 2190 Lachmach R. 4830	5	Rainbow-Tyee Alternative is much preferred because the route would not parallel any salmonid streams and would not require development of new road access. Known salmonid populations are considerably smaller along this alternative. Of the other two alternatives, the Prudhomme-Minerva-Lachmach route is slightly preferable because it avoids the Work Channel tributary.
Prudhomme (C), Minerva (V), Lachmach (E)	Prudhomme Ck. Lachmach R.	2	Prudhomme Ck. Lachmach R.	24	7020 as above	4	
Rainbow (B) Tyee (D)	McNeil R. Aberdeen Ck. Inver Ck. Marigonish Ck.	4	None	0	0	4	
2. Ayton (G)	Skeena R. Scotia R.	2	None	0	0	0	Neither alternative is preferred over the other. Both routes cross streams below salmonid spawning and rearing areas and would thus have little or no effect on the resource.
Telegraph (H)	Skeena R.	1	None	0	0	0	
3. Mt. Bucey (J)	Skeena R. (4) Arga Ck.	5	Skeena R.	6	Unknown	2	Mt. Bucey alternative is slightly preferable. It parallels existing route for most of length, and would therefore not involve opening up access for new route.
Kasiks (K)	Skeena R.	4	Skeena R.	6	Unknown	3	
4. Exchamsiks Crescent (M)	None	0	Skeena R.	1	Unknown	1	Exchamsiks Ridge alternative is preferred, as no encroachment on the Skeena River is required for tower construction as in case of the Exchamsiks Crescent route.
Exchamsiks Ridge (N)	None	0	None	0	Unknown	0	

TABLE D-4 - (Cont'd)

Route Alternatives Compared (Listed by Route Segments)	Salmonid Streams and Skeena Mainstem Channels Crossed by Route		Salmonid Spawning Streams Paralleled by Route		Average Salmon Escapement Within 2 km Downstream of Stream Crossings and 0.5 km of Paralleling Streams	No. of Known Salmonid Spawning or Rearing Areas 2 km Downstream of or 0.5 km Upstream of Route, and Adjacent to the Route (within 0.5 km)	Preferred Route From Fishery Resource Standpoint
	Streams	Total No.	Streams	Total Length (km)			
5. Hudson (P), Dasque (W)	Skeena R. (13) Middle Ck. Whitebottom Ck.	15	Skeena R.	10	Unknown	12	Alternative routes on the north side of the Skeena River, including the Exstew East and Shames segments, are preferred because they are close to fewer salmonid spawning or rearing areas, and cross fewer mainstem channels with salmonid rearing potential. The Shames North alternative is slightly preferable to the Shames South alternative. Of the routes on the south side of the Skeena River, the Exstew-Crossing-Dasque alternative is preferable because it avoids important mainstem spawning and rearing areas near km 95 S to 100 S of the Dasque segment.
Exstew (Q) Crossing (S), Dasque (W)	Skeena R. (8) Middle Ck. Whitebottom Ck.	10	Skeena R.	3	Unknown	8	
Exstew (Q), Exstew East (V), Shames South (Y) and Klakelse Crossing (Z)	Skeena R. (4) Exstew R. Esker Slough Shames R.	7	Skeena R.	10	1550 (Shames R. and Slough)	6	
Exstew (Q), Exstew East (V) Shames North (Y) and Klakelse Crossing (Z)	Skeena R. (4) Exstew R. Shames R.	6	Skeena R.	5	1550 (Shames R. and Slough)	4	

APPENDIX E

MINING

APPENDIX E

MINING

CONTENTS

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E.2	INDUSTRIAL MINERALS	E - 2
E.3	MINERAL CLAIMS	E - 3
E.4	MINERAL DEPOSIT LAND USE PLANNING	E - 3

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E-1	Drill Log from Kwinitsa Hole No. 4
E-2	Analysis of Evaporated Salt from the Kwinitsa Prospect
E-3	Analyses of Limestone
E-4	Mineral Showings, Rock Quarries, Sand Pits and Gravel Pits in the Study Area

APPENDIX E
MINING

E.1 BASE METALS

The Iron Cap prospect (70) lies on the lower slopes of Mt. Remo, near the Skeena River. The showing is in Late Paleozoic greenstone near a small stock of Early Tertiary granodiorite. Mineralization consists of a small pod of massive magnetite (Fe_3O_4), chalcopyrite ($CuFeS_4$), and pyrhotite ($Fe_{1-x}S_x$) and patchy mineralization associated with silicified zones (James 1927).

The Talus Creek prospect (72) also lies on the southeastern slopes of Mt. Remo. The showing consists of molybdenite (MoS_2) at the contact between a sequence of Late Paleozoic volcanic and minor sedimentary rocks with a Tertiary granodiorite intrusion (Resource Data Section 1980).

The Autumn prospect (73) also lies on the lower slopes of Mt. Remo. Mineralization consists of chalcopyrite and pyrite (FeS_2) with minor bornite (Cu_5FeS_4). The mineralization is in silicified zones within Late Paleozoic andesite and at a limestone contact (Galloway 1967). Most of the mineralization is along sheared zones. Gold-bearing quartz has been reported in some of these zones (Clothier 1917). Two assays have been reported as follows: a hand sorted sample assayed 1.5 percent Cu, trace Au, trace Ag and a second sample from an open cut and over a 10-foot (3 m) width assayed 1.9 percent Cu, trace Au and 0.4 oz/short ton (31.2 g/t in Ag). A tunnel under the open cut intersected only a small quantity of mineralization (Galloway 1967).

E.2 INDUSTRIAL MINERALS

There are two prospects in the area, Kwinitsa salt and A.E. Barr limestone, that have been utilized for industrial minerals. The Kwinitsa salt prospect is in Recent fluvial sediments at the mouth of Kwinitsa Creek. The A.E. Barr limestone quarry is in Late Paleozoic meta-sedimentary and meta-volcanic rocks.

Salt (NaCl) has been deposited in a basin on the Kwinitsa prospect (75) which is bounded by foliated quartz diorite on the west and by Late Paleozoic amphibolite and mafic schists on the northeast (Forbes 1913). Four holes have been drilled to explore the deposit and the log of the only hole into the main zone is summarized in Table E-1. Although the drill hole penetrated 30 feet (9.1 m) of salt with mud it was still in the salt at the bottom and the total thickness is unknown. The basin is 1.9 km long and a maximum of 1.0 km wide. The dip of the strata is unknown, but it is presumed that the salt is closer to surface on the northwestern margin of the basin than indicated by the drill hole because a few tons of salt were produced prior to 1913. An analysis of the salt is summarized in Table E-2 (Forbes 1913). It is expected that the deposit would thin toward the northwestern margin where the valley narrows and bedrock is closer to the surface.

The A.E. Barr limestone quarry (74) is north of the mouth of the Shames River. The limestone ($CaCO_3$) is brown-grey, green-grey, blue-grey and white, medium to coarse-grained and interbedded with andesite and quartz mica schist of Late Paleozoic age (McCammon 1954). There is some scattered pyrite and flakes of a green micaceous mineral in the limestone. Much of the limestone is sheared with numerous gouge zones as much as 0.3 m wide and containing clay and serpentine. The limestone ranges from 100 to 300 feet (30.5 m to 91.4 m) thick and it is approximately 145 feet (44.2 m) thick at the quarry. The limestone strikes approximately 055° and dips 68° to 77° SE. The unit has been traced for 0.8 km to the northeast, where it still continues, but it lenses out on the other side of the ridge. Analyses of the limestone are summarized in Table E-3. It is evident from the analyses that this limestone varies in quality. Whether extensive areas of good limestone can be found in this horizon or in the other Late Paleozoic or Triassic strata in the area is unknown.

E.3 MINERAL CLAIMS

Mineral claims are staked for one or more of the following reasons:

1. The prospector has found mineralization which he considers to be of interest.

2. A geochemical or geophysical anomaly has been discovered during reconnaissance work and the claims are staked in order to provide time to assess the anomaly.

3. A favourable geological environment is present, based on some geological model for the area.

4. Others have staked in the area and the prospector stakes on speculation. Usually such staking is done around other claims where significant mineralization has been discovered.

Some of the claims that are not on showings may have been recorded for reasons 2 or 3; this could explain some of the discrepancies between the location of showings and claims.

E.4 MINERAL DEPOSIT LAND USE PLANNING

Five categories have been established to denote mineral potential (Maps GM-1 to GM-7). There are no areas of Category 1, where there would be mineral production or deposits nearing production. There is one region of Category 2C within the study area. This region is west of Terrace and includes the A.E. Barr quarry together with the Autumn, Talus Creek, JZ and Iron Cap prospects. Regions designated 2C contain some small deposits that are known and they are regions where additional small deposits are possible. West of Terrace, around Mt. Remo, south of Graveyard Point, southeast of Hudson Bay Flats, around Prince Rupert and in a long belt near Minerva Lake and the mouth of the Khyex River are areas designated 3C. In these areas no deposits are known, but they are geologically favourable for the discovery of small deposits. Areas designated 4 have been outlined at Terrace, southwest and north of Shames and around Tyee. The status is indeterminate in these areas because of a lack of information. In areas of Category 5 there is no indication of mineral potential; this category has been assigned to a large part of the study area, extending from Hudson Bay Flats in the east to Telegraph Point in the west. The area includes the Kwinitsa salt deposit which is not regarded as significant.

TABLE E-1

DRILL LOG FROM KWINITSA HOLE NO. 4

Depth		
(ft)	(m)	Description
0-10	0-3.0	Surface soil and gravel
10-110	3.0-33.5	Grey impervious clay
110-220	33.5-67.1	Salt mud
220-250	67.1-76.2	Crystalline salt with mud

TABLE E-2

ANALYSIS OF EVAPORATED SALT FROM THE KWINITSA PROSPECT

Compound	(%)
NaCl	98.15
$CaSO_4$	1.82
$MgSO_4$	Trace
Insoluble residue	Trace
$Fe_2O_3 + Al_2O_3$	None
$MgCl_2$	None
$CaCl_2$	None
Na_2SI_4	None
$CaCO_3$	None
$MgCO_3$	None
TOTAL	99.97

TABLE E-3

ANALYSES OF LIMESTONE
(%)

Sample Description	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO*[1]	Equiv $CaCO_3$	Equiv $MgCO_3$	Acid Insoluble
1. White quarry limestone - chip sample over 32 feet (9.8 m)*[2]	-*[3]	0.35	-	48.9	4.4	87.3	-	2.5
2. Discoloured limestone southeast of quarry - chip sample over 80 feet (24.4 m)*[2]	-	0.71	-	49.0	2.4	87.5	-	5.9
3. At northwest contact - chip sample over 20 feet (6.1 m)*[2]	-	0.51	-	51.6	1.3	92.1	-	4.0
4. Southeast of sample 3 - chip sample over 64 feet (19.5 m)*[2]	-	0.14	-	53.1	1.6	94.8	-	1.2
5. Southeast of sample 4 - chip sample over 72 feet (21.9 m)*[2]	-	0.42	-	50.6	2.5	90.3	-	3.5
6. Grab sample shipping rock*[2]	-	-	-	53.8	1.3	96.0	-	-
7. Loght coloured limestone*[2] *[4]	2.4	0.3	Trace	-	-	97.1	Trace	-
8. Dark coloured limestone*[2] *[4]	7.9	0.9	0.1	-	-	91.1	Trace	-
9. No description*[2] *[4]	0.6	-	0.6	-	-	97.6	0.84	-
10. No description*[2] *[4]	1.1	1.6*[5]		-	-	96.9	1.68	-
11. Grey limestone near east end of deposite*[2] *[4]	9.0	2.0*[5]		-	-	88.9	0.2	-
12. White limestone 0.5 miles (0.8 km) from east end of deposit*[2] *[4]	2.0	1.0*[5]		-	-	97.0	Trace	-
13. No description*[2] *[4]	7.2	1.6*[5]		-	-	90.2	Trace	-

---

*[1] Acid soluble.

*[2] Samples 1 to 6 (inclusive) are from McCammon 1954 and samples 7 to 13 (inclusive) are from Goudge 1964.

*[3] Dash (-) indicates none recorded in the reference.

*[4] Sample width is not recorded in the reference.

*[5] Analysis is the sum of percent (%) Fe_2O_3 + Al_2O_3.

TABLE E-4

MINERAL SHOWINGS, ROCK QUARRIES, SAND PITS AND GRAVEL PITS IN THE STUDY AREA

No.	Name of Deposit	Type	Size (m³)	Remarks
1	Substation	Rock		
2	Pit 237			Needs re-evaluation
3	Morse Basin			Needs re-evaluation
4	Kloiya Bay Foreshore	Winter sand	8 000	
5	Act, Lou, Saga, Bingo, Gisela	Mineral claims		
6	Prudhomme Lake	Rock		
7	Prudhomme Lake B	Rock		Old, unused
8	Prudhomme Lake C	Rock		
9	Prudhomme Lake D	Rock		Large
10	Prudhomme Lake E	Rock		Small
11	Rainbow Lake A	Rock		Old, unused
12	Rainbow Lake B	Rock		Old, unused
13	Rainbow Lake C	Rock		Old, unused
14	Gamble Creek A	Rock		Old, unused
15	Gamble Creek B	Rock		Old, unused
16	Gamble Creek C	Rock		Old, unused
17	Green River north	Winter sand	13 000	
18	Green River			Needs re-evaluation
19	Mile 66.3			Needs re-evaluation
20	Mile 64.8	Rock		
21	Aberdeen Point	Rock		
22	Aberdeen Point			Possibly quarry
23	Khyex River C	Rock		Large
24	Ayton Island	Gravel		
25	Rocky	Rock		
26	Igneous Creek	Borrow	5 000	
27	Log Creek	Borrow	4 600	
28	Cobalt	Mineral Claim		
29	Skeena River Bar	Gravel		Depleted
30	52.8 Mile	Rock		Depleted
31	Phenocryst	Crush base	267 000	
32	Gneiss	Borrow	3 000	
33	Kwinitsa	Rock		
34	East Kwinitsa	Rock		Depleted? crusher in use
35	Avalanche	Borrow	100 000	
36	Selma Island	Gravel		
37	Selma East	Rock		Old
38	Polymar West	Select base	14 000	

TABLE E-4 - (Cont'd)

No.	Name of Deposit	Type	Size (m³)	Remarks
39	Polymar Creek	Borrow	350 000	
40	Polymar Bar	Paving aggregate	100 000	Top quality
41	Rock Quarry	Rock	Unlimited	
42	Sand Pit	Sand		Needs re-evaluation
43	Tunnel	Rock		
44	Salvus Flats	Borrow	300 000	
45	Old Saluvs Camp			Needs re-evaluation
46	Exchamsiks River	Rock		Old, 2 quarries
47	Hayes			Needs re-evaluation
48	Hudson Bay West	Gravel		In use
49	Polywog Creek	Select base	26 800	
50	Hudson Bay	Gravel		In use
51	Breccia			Needs re-evaluation
52	Andesite	Paving aggregate	105 000	Top Quality
53	Andesite South			Needs re-evaluation
54	Mile 24			Depleted
55	Exstew River			Needs re-evaluation
56	Beta	Surfacing aggregate	100 000	Top quality
57	Alpha	Surfacing aggregate	99 000	Top quality
58	Exstew River East			Needs re-evaluation
59	Esker Creek	Paving aggregate	20 000	Top quality
60	Graveyard Point	Gravel		
61	Sullivan	Mineral claim		Cancelled
62	Shames			Depleted
63	Amesbury West	Gravel		Old
64	Amesbury			Needs re-evaluation
65	Amesbury East	Gravel		Old, large
66	Scree Creek			Needs re-evaluation
67	Lakelse Northwest	Gravel		Old
68	Lakelse Northeast	Gravel		Old
69	Zymagotitz River	Gravel		Old
70	Iron Cap	Iron, copper		Showing
71	JZ	Iron, copper (?)		Showing
72	Talus Creek	Molybdenum		Showing
73	Autumn	Copper, gold, silver, iron		Showing
74	A.E. Barr	Limestone		
75	Kwinitsa	Salt		Showing
76	O.K. 2	Mineral claims		
77		Mineral claims		Cancelled

APPENDIX F

FORESTRY IMPACTS

APPENDIX F

FORESTRY IMPACTS

CONTENTS

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F-2	Losses of Good and Medium Growing Sites for Route Alternatives

APPENDIX F
FORESTRY IMPACTS

F.1 DETAILED METHODOLOGY

(a) Parameters

The potential forestry impacts were summarized for each segment in Section 5.2. For calculation purposes the cleared rights-of-way were assumed to be 60 m wide when parallel to the existing 287 kV line, 70 m across the islands in the Skeena River, and 80 m for a new separate right-of-way. The total area impacted in any segment would vary considerably depending on the final location of the line. The right-of-way area requirements would be affected by the danger tree strip width which is dependent on such factors as tree height and growth rate, land slopes and conductor height. Any change in route would of course, vary the sites, volumes and species affected.

The cleared widths of 60, 70 and 80 m yield an impact area of 6, 7, and 8 ha/km respectively. The area impacted in productive forests would be greater regardless of the present timber height or type. This is because trees on the "danger tree strip" would have to be felled for line security purposes, and additional land rendered unavailable for meaningful timber production.

The forest area requirements would be approximately 6 ha/km where an existing right-of-way is closely paralleled since one danger tree strip will be common to both transmission lines. Similarly the impact can be reduced where the route follows non-forest areas such as the Skeena River.

(b) Methodology

(i) Area of Segments

The routes were transposed from 1:50 000 scale topographic maps to Ministry of Forests and B.C. Timber forest cover maps.

Areas were calculated for the forest types intersected by the routes and summarized by timber volume and site quality for each segment.

(ii) Volumes

Volume calculations by segment were made of the mature timber stands. These were based on the map area volume listings prepared for the Skeena and Hecate PSYU's by the Inventory Division of the Ministry of Forests. Volumes are given to close utilization standards (17.1 cm DBH; gross volume minus decay only).

(iii) Site Classes

Site class areas were calculated by using the Ministry of Forests Site Class maps. The Ministry's inventory reports were used to determine the mean annual increments (MAI) for each segment.

(iv) Forest Alienation Locations

Forest land alienations were noted on each segment and are shown on Maps FO-1 to FO-7.

(v) Sensitivity

The areas of each sensitivity grouping were calculated for each segment. These areas were used to establish an impact rating for each segment.

(vi) Impact

A. General

No benefits or mitigation of forest values lost are foreseen. The impact would be the value of each particular forest area lost from production or utilization.

B. Mature Timber Losses

For the purpose of this report mature timber losses were estimated to be one-third of the coniferous volume and all of the deciduous volume.

Mature volumes along the route were calculated by segment (Table F-1) and are estimated to be lost owing to factors abnormal to regular harvesting practices. These factors include restricted accessibility in confined areas of a right-of-way, poor logging chance, unfavourable market conditions and lower utilization standards. Under these circumstances stands containing mainly low grade pulpwood would not be logged.

C. Growing Capacity Losses

Forest land has been appraised as a part of a larger managed tree farm. The removal of productive forest land generally results in an annual loss of wood production. The value of the forest land is the present value of the perpetual annual income that would have been generated by that forest land as a part of a sustained yield operation. An assumption of this appraisal is that there exists adequate mature and immature stands to sustain annual harvests from the whole tree farm. The immature stands and the bare land are valued together, based on the MAI of the land which reflects the growing capacity of the land. The data base used in this report

TABLE F-1

AREAS OF GROWING STIES, CROWN TIMBER VOLUMES AND MEAN ANNUAL INCREMENTS AFFECTED FOR EACH SEGMENT WITH ACCESS COMMENTS

Segment	Site Areas (ha) Good	Medium	Poor	Low	Non-Productive	Total	Crown Timber Volume (m^3)	MAI (m^3)	Access
A. Kloiya	-	4.8	-	27.9	1.7	34.4	-	56.0	fair to good
B. Rainbow	-	-	11.5	52.6	11.3	75.4	4 549	63.1	fair to good
C. Prudhomme	-	17.2	-	32.9	16.3	66.4	562	120.3	none
T. Channel	9.1	25.3	2.8	6.8	2.8	46.8	33 361	183.4	limited
U. Minerva	-	7.5	14.1	7.7	7.1	36.4	16 852	85.4	limited
D. Tyee	-	15.1	14.2	21.3	11.6	62.2	14 302	137.7	limited
E. Lachmach	-	42.1	5.6	6.8	19.3	73.8	2 005	222.3	good
F. Khyex	-	8.7	8.6	11.8	0.8	29.9	13 630	80.0	difficult
G. Ayton	-	-	45.8	6.6	44.6	97.0	24 892	140.7	fair to poor
H. Telegraph	-	25.2	36.3	-	11.4	72.9	17 760	223.7	fair to poor
I. Khtada	29.1	35.5	26.0	-	14.2	104.8	259 793	331.4	poor
J. Mt. Bucey	12.3	18.8	-	-	4.0	35.1	63 816	132.9	seasonal
K. Kasiks	40.5	3.1	-	-	1.0	44.6	44 921	225.8	seasonal
L. Salvas	3.8	15.9	-	-	6.3	26.0	-	77.4	good
M. Exchamsiks Crescent	-	1.9	-	-	0.5	2.4	-	6.8	good
N. Exchamsiks Ridge	-	1.6	6.0	-	3.7	11.3	26 364	17.2	very difficult
O. Mt. Jackman	35.1	34.8	7.7	-	5.8	83.4	78 182	325.9	seasonal
P. Hudson	13.7	21.3	-	-	7.4	42.4	10 777	149.3	seasonal
Q. Exstew	4.3	6.1	-	-	6.7	17.1	39 153	44.8	good
V. Exstew East	8.0	7.5	-	-	5.0	20.5	38 337	69.4	good
S. Crossing	12.6	2.7	-	-	1.2	16.5	-	76.5	seasonal
W. Dasque	6.8	42.3	4.9	-	20.5	74.5	2 960	197.6	seasonal
X. Shames North	-	35.5	17.9	-	2.0	55.4	143 720	161.8	fair
Y. Shames South	6.0	24.5	11.9	-	6.0	48.4	-	142.6	good
Z. Klakelse Cross.	15.5	9.8	10.8	-	2.9	39.0	6 562	138.0	seasonal
R. Lakelse	3.2	27.9	23.8	1.8	2.7	59.4	9 339	163.9	good

applies to natural stands not managed by intensive silvicultural practices.

F.2 DETAILED FORESTRY DATA

The data extracted from all information sources was tabulated by segment for the determination of impacts on the forest resource. This detailed information is presented in Table F-1.

TABLE F-2

LOSSES OF GOOD AND MEDIUM GROWING SITES FOR ROUTE ALTERNATIVES

	Area (ha)			
Alternative	Total	Good Site	Medium Site	Sum of Good and Medium Sites
CTE	184.2	9.1	84.6	93.7
CUE	176.6	0	66.8	66.8
BD	137.6	0	15.1	15.1
G	97.0	0	0	0
H	72.9	0	25.2	25.2
J	35.1	12.3	18.8	31.1
K	44.6	40.5	3.1	43.6
M	2.4	0	1.9	1.9
N	11.3	0	1.6	1.6
PW	116.9	20.5	63.6	84.1
QSW	108.1	23.7	51.1	74.8
QVYZ	125.0	33.8	47.9	80.7
QVXZ	132.0	27.8	58.9	86.7

APPENDIX G

RECREATION FEATURES

APPENDIX G

RECREATION FEATURES

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TABLES

Table No.

G-1 Recreation Features in the Skeena Valley and the Diana-Prudhomme Lake System - Angling Areas

G-2 Wildlife Habitats

TABLE G-1

RECREATION FEATURES IN THE SKEENA VALLEY AND THE DIANA-PRUDHOMME LAKE SYSTEM*[1]

ANGLING AREAS*[2]

Location	Species Sought
Kloiya River (km 4)	Steelhead, Cutthroat, Dolly Varden
Prudhomme River (km 6)	Cutthroat, Coho
Lachmach River near Work Channel (km 20N)	Steelhead
Kwinitsa River Slough (km 54)	Dolly Varden
Sandbar near Selma Is. at N. bank of Skeena River (km 61)	Cutthroat, Dolly Varden
43 Mile Bar, N. bank of Skeena River across from Alder Creek (km 63 and 66)	Cutthroat, Dolly Varden, Coho, Chinook
Devil's Island W. side (km 69N)	Coho, Cutthroat, Dolly Varden
Exchamsiks Slough (km 79)	Coho, winter ice fishing for Dolly Varden, Cutthroat
Slough on N. bank of Skeena River opposite from Gitnadoix Valley (km 82 and 84)	Cutthroat, Dolly Varden, Coho at km 83
Gitnadoix River mouth (km 82)	Coho, Chinook
Slough on N. bank of Skeena near Hudson Bay Flats (km 90)	Cutthroat, Dolly Varden
Exstew River mouth (km 95N)	Coho
Esker Bar (km 100C)	Coho, Chinook, Steelhead
Esker Slough (km 100N)	Cutthroat, Coho, winter ice fishing for Trout
Shames Slough (km 103M to 106N)	Coho, Steelhead, Cutthroat, Dolly Varden
Dasque Creek Slough near IR85 (km 104S)	Dolly Varden, Coho, Cutthroat
Dasque Creek mouth (km 106S)	Cutthroat, Coho

TABLE G-1 - (Cont'd)

Location	Species Sought
Graveyard Point (km 106N)	Cutthroat, Trout
Sand bar near Graveyard Point (km 108N)	Coho, Steelhead
Slough near Graveyard Point (km 109N)	Cutthroat, Dolly Varden
Marsh near mouth of White Bottom Creek (km 110S)	Cutthroat (pond fishing)
Branch Channel of Skeena R. near Amsbury (km 116)	Coho, Steelhead, Trout
Lakelse River mouth (km 117)	Coho, Chinook, Steelhead, Dolly Varden
Lakelse River (km 118)	Coho, Cutthroat, Trout
Alwyn Creek (km 122)	Cutthroat, Dolly Varden

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*[1] In addition to Table 4.2-3.

*[2] Source: Lister, D.B. (pers. com.).

TABLE G-2

WILDLIFE HABITATS*[1]

Location	Species Observed
Khyex River mouth (km 26S to 35)	Waterfowl
Ayton Island (km 36S to 40S)	Waterfowl
N.E. slope of Telegraph Ridge (km 43S to 45S)	Goats
Khtada River mouth (km 50)	Waterfowl
Feak Creek Delta (km 56)	Waterfowl
Alder Creek Slough (km 61 to 64)	
Shorelands on S. bank of Skeena R. opposite Kasiks R. (km 65 to 71S)	Moose
Kasiks R. mouth (km 69N to 76S)	Moose, Waterfowl
Exchamsiks River mouth (km 76N to 79)	Goats, Moose
Gitnadoix River mouth (km 82 to 84)	Moose, Waterfowl
Shoreland on N. bank of Skeena R. opposite Gitnadoix R. (km 79 to 84)	Moose, Waterfowl
Shoreland S.W. of Esker Bar (km 98S)	Moose
Exstew River mouth (km 96N to 98N)	Moose, Waterfowl
Shames Slough (km 100M to 106N)	Moose, Waterfowl
Slough N. of Whitebottom Creek (107S to 112S)	Moose

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*[1] Source: Stevenson, S.K. (pers. com.).

APPENDIX H

LAND STATUS AND USE IN THE SKEENA-RUPERT STUDY AREA

APPENDIX H

LAND STATUS AND USE IN THE SKEENA-RUPERT STUDY AREA

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TABLES

Table No.

H-1 Water Rights

H-2 Crown Tenures

H-3 Water Licences

H-4 Private Lands

TABLE H-1

WATER RIGHTS

Mineral Springs*[1]

Map Reference No.	Map No. and Segment	File No.	Location	On Proposed Route
MS1	LS-2/D	1016691/011356	East of Windsor Point	No
MS2	LS-2/F	16030^W	Frizzell Hot Springs west of Windsor Point	No

Order in Council Reserves*[2]

Map Reference No.	Map No. and Segment	Water Reserve No.	Date	Stream	On Proposed Route
OIC 59	LS-1/A	12	13 Jan 1914	Kloiya River	No
OIC 233	LS-2/D	21	10 Mar 1927	Ecstall River & tributary	No
OIC 372	LS-2/F	23	16 Apr 1928	Skeena River & tributary	No

Community Watershed*[3]

Map Reference No.	Map No. and Segment	System	Service To	Area	On Proposed Route
Watershed reserve	LS-1/A	Wolf Creek	Port Edward	14.5 km²	No

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*[1] Mineral (Hot) Springs - There is a blanket reserve protecting all hot-springs in B.C. Applications for use or development must be referred to the Ministry of Lands, Parks and Housing.

*[2] Order-in-Council Water Reserve - Section 45 Water Act

Reserves water from use (e.g. placer mining), for study or for specific use (e.g. flooding)

Recorded in Reserve Books (2 copies) - draughting
- comptroller

*[3] Community Watershed - Provincial water concerned with one of three classes of "pristine" water i.e. it is untreated. Once a community routinely treats water supply it is not maintained on maps. Water Rights guidelines stipulate that reservoirs less than 15.5 km² cannot be traversed without ministerial approval.

TABLE H-2

CROWN TENURES

Map Reference No.	Map No./ Segment	File No.	Purpose	Area (ha)	On Proposed Route
Crown Leases					
L1	LS-1/B	0314347	Commercial	0.46	Yes
L2	LS-1/B	0311098	Recreational	0.40	No
L3	LS-3/H	0345781	Quarry	3.53	No
L4	LS-6/X	0252031	Agriculture	43.71	Yes
L5	LS-7/R	0293048	Grazing	64.75	No
L6	LS-7/R	0208797	Agriculture	64.75	No
Crown Easements					
E1	LS-1/A	0266353	Electric transmission	4.78	No
E2	LS-7/R	0268895/ 0348345	Natural gas pipeline	0.00	Yes, in places
E3	LS-7/R	0267725	Electric transmission	436.06	No
E4	LS-1/A	0260382	Electric transmission	726.90	N/A
Crown Reserves					
R1	LS-1/A	0320503	Quarry	N/A	No
R2	LS-1/A-D	0215326	Hwys. right-of-way	N/A	No
R3	LS-1/A	0295558	Quarry	N/A	No
R4	LS-1/A	0280844	Fisheries cabin	N/A	Yes
R5	LS-1/A	0312762	Hwys. right-of-way	N/A	No
R6	LS-1/A	0182160	Quarry	N/A	No
R7	LS-1/B	0331200	Hwys. right-of-way	N/A	Yes
R8	LS-1/D	0092616	Quarry	136.55	Yes
R9	LS-1/D	0092616	Hwys. right-of-way	N/A	Yes

TABLE H-2 - (Cont'd)

Map Reference No.	Map No./ Segment	File No.	Purpose	Area (ha)	On Proposed Route
Crown Reserves - (Cont'd)					
R10	LS-2/D	0242720	Fish and Wildlife	2.83	No
R11	LS-2/D	0291349	Quarry	40.47	Yes
R12	LS-2/D	0200687	Right-of-way	2.00	No
R13	LS-2/F	0246168	Quarry	125.13	No
R14	LS-3/F	0230088	Hwys. right-of-way	53.75	Yes
R15	LS-3/F	0331953	Hwys. right-of-way	N/A	No
R16	LS-3/F	0347552	Hwys. right-of-way	N/A	No
R17	LS-4/I	0278414	Quarry	25.33	No
R18	LS-4/K	0259820	Quarry	63.13	No
R19	LS-4/K	0263971	Hwys. right-of-way	N/A	Yes
R20	LS-4/K	0220471	Forestry	176.04	Yes
R21	LS-5/L	0294912	Quarry	N/A	No
R22	LS-5/L	0288575	Forestry	202.34	No
R23	LS-5/L	0282983	Forestry	129.50	Yes
R24	LS-5/L	0201451	Hwys. right-of-way	N/A	Yes
R25	LS-5/O	0271471	Hwys. right-of-way	0.67	No
R26	LS-5/O	0236466	Hwys. right-of-way	N/A	Yes
R27	LS-5/O	0280528	Quarry	29.83	No
R28	LS-5/O	0280528	Quarry	1.34	No
R29	LS-5&6/O,Q	0297329	Forestry	N/A	Yes
R30	LS-7/V,R	0202327	Quarry	N/A	No
R31	LS-7/V,R	0192277	Quarry	4.86	No
R32	LS-7/R	0222495	Fish and Wildlife	0.81	No

TABLE H-3

WATER LICENCES

Map Reference No.	Map No./ Segment	Water Licence No.	Permittee	Purpose	Source Area or Approximate Location	On Proposed Route
W1	LS-1/A	CL29655	B.C. Timber	Industrial	Kloiya River	Yes
W2	LS-1/A	CL29658	B.C. Timber	Storage	Kloiya River	No
W3	LS-1/B,C	CL18074	B.C. Timber	Storage	Prudhomme and Taylor Lakes	Yes
W4	LS-1/B,C	CL18075	B.C. Timber	Industrial	Prudhomme and Taylor Lakes	No
W5	LS-1/B	CL26633	B.C. Timber	Industrial	Rainbow Lake	No
W6	LS-1/B	CL26634	B.C. Timber	Storage	Rainbow Lake	No
W7	LS-1/B	CL19737	E. & V. Warner	Domestic	Hansen Creek	No
W8	LS-2/D	FL10471	CNR	Industrial	Stapledon Creek	Yes
W9	LS-3/G	CL56895	CIPA Industries Ltd.	Industrial	Scotia River	Yes
W10	LS-7/V	CL42014	A. & B. Chernick	Domestic	Delta Creek	No
W11	LS-7/V	CL42015	A. & B. Chernick	Power	Delta Creek	No
W12	LS-7/R	CL26199	Fisheries Research Board of Canada	Conservation: Fish Counting Fence	Lakelse River	Yes
W13	LS-7/R	CL54120	R.G. Sheppard	Irrigation, Domestic	Slough	No
Applications for Water Licences						
WA1	LS-6/X,Y	6000026	V. Johnson	Domestic	Spring	Yes
WA2	LS-6/X,Y	6000027	V. Johnson	Irrigation	Slough of Skeena	No

TABLE H-4

PRIVATE LANDS

Map Reference No.	Map No./Segment	Present Land Use*[1]	Area (ha)	On Proposed Route
CG 1	LS-1/A	Substation/site	N/A	N/A
CG 2	LS-1/A	Substation/site	N/A	N/A
CG 3	LS-1/A	Water distribution	121.12	Yes
CG 4	LS-1/A	N/A	N/A	No
CG 5	LS-1/A	Vacant	N/A	Yes
CG 6	LS-1/A	Vacant	N/A	No
CG 7	LS-1/A	Vacant	48.56	No
CG 8	LS-1/A	Vacant	N/A	Yes
CG 9	LS-1/A	Forest related	N/A	Yes
CG 10	LS-1/A	N/A	N/A	Yes
CG 11	LS-1/A	N/A	N/A	No
CG 12	LS-1/A,B	Seasonal dwelling	0.79	No
CG 13	LS-1/A	-	-	-
CG 14	LS-1/A	Forest related	N/A	Yes
CG 15	LS-1/B	Seasonal resort	0.79	Yes
CG 16	LS-1/B	Residential	0.30	Yes
CG 17	LS-1/B	Residential	0.30	Yes
CG 18	LS-1/B	Residential	0.28	Yes
CG 19	LS-2/D	Vacant	3.14	No
CG 20	LS-2/D	Vacant	N/A	Yes
CG 21	LS-2/F	Vacant	0.70	No
CG 22	LS-2/F	Vacant	0.16	No
CG 23	LS-2/F	Outbuilding	10.07	No
CG 24	LS-3/G	N/A	7.28	Yes
CG 25	LS-3/I	Vacant	3.48	Yes
CG 26	LS-4/I	-	28.62	No
CG 27	LS-4/I	Vacant	17.76	No
CG 28	LS-4/I	Vacant	19.62	No
CG 29	-	Residential	Improvs only	No
CG 30	LS-4/I	Vacant	48.56	No
CG 31	LS-4/I	Vacant	16.18	No
CG 32	LS-4/I	Vacant	15.47	No
CG 33	LS-5/L	Vacant	17.48	No
CG 34	LS-5/L	Vacant	27.56	Yes
CG 35	LS-6/Y	Residential	59.89	Yes
CG 36	LS-6/Y	N/A	63.13	Yes
CG 37	LS-6/Y	Vacant	59.08	Yes
CG 38	-	Vacant	83.36	Yes
CG 39	LS-6/Y	Vacant	62.32	Yes
CG 40	LS-6/Y	Vacant	15.58	Yes

TABLE H-4 - (Cont'd)

Map Reference No.	Map No./Segment	Present Land Use*[1]	Area (ha)	On Proposed Route
CG 41	LS-6/Z	Vacant	27.25	Yes
CG 42	LS-6/Z	Vacant	5.26	No
CG 43	LS-6/Z	Vacant	23.33	Yes
CG 44	LS-6/Z	Vacant	52.61	Yes
CG 45	LS-7/R	Vacant	30.34	No
CG 46	LS-7/R	Vacant	32.73	No
CG 47	LS-7/R	Vacant	4.05	No
CG 48	LS-7/R	Agricultural	16.18	No
CG 49	LS-7/R	Residential	-	No
CG 50	LS-7/R	Residential	-	No
CG 51	LS-7/R	Vacant	39.73	No
CG 52	LS-7/R	Residential	47.66	No
CG 53	LS-7/R	Residential	4.05	No
CG 54	LS-7/R	Residential	4.19	No
CG 55	LS-7/R	Residential	4.05	No
CG 56	LS-7/R	Vacant	4.05	No
CG 57	LS-7/R	Vacant	43.42	No
CG 58	LS-7/R	Vacant	8.19	No
CG 59	LS-7/R	Residential	8.19	No
CG 60	LS-7/R	Agricultural	8.19	No
CG 61	LS-7/R	Residential	8.34	No
CG 62	LS-7/R	Agricultural	8.49	No
CG 63	LS-7/R	Residential	11.13	No
CG 64	LS-7/R	Residential	9.70	No
CG 65	LS-7/R	Agricultural	9.47	No
CG 66	LS-7/R	Vacant	1.43	No
CG 67	LS-7/R	Agricultural	54.02	No
CG 68	LS-7/R	Residential	8.95	No
CG 69	LS-7/R	Residential	60.13	No
CG 70	LS-7/R	Residential	4.05	No
CG 71	LS-7/R	Residential	3.89	No
CG 72	LS-7/R	Vacant	27.25	No
CG 73	LS-7/R	Residential	-	No
CG 74	LS-7/R	Residential	8.77	No
CG 75	LS-7/R	Vacant	0.14	No
CG 76	LS-7/R	Vacant	0.14	No
CG 77	LS-7/R	Vacant	0.47	No
CG 78	LS-7/R	Vacant	0.47	No
CG 79	LS-7/R	Vacant	0.48	No
CG 80	LS-7/R	Vacant	0.54	No
CG 81	LS-7/R	Vacant	0.47	No
CG 82	LS-7/R	Vacant	0.44	No

TABLE H-4 - (Cont'd)

Map Reference No.	Map No./Segment	Present Land Use*[1]	Area (ha)	On Proposed Route
CG 83	LS-7/R	Residential	8.25	No
CG 84	LS-7/R	Residential	8.42	No
CG 85	LS-7/R	Residential	8.35	No
CG 86	LS-7/R	Vacant	8.26	No
CG 87	LS-7/R	Residential	8.25	No
CG 88	LS-7/R	Residential	4.73	No
CG 89	LS-7/R	Vacant	75.40	Yes
CG 90	LS-7/R	Vacant	253.33	No
CG 91	LS-7/R	Vacant	181.27	Yes
CG 92	LS-7/R	Substation	12.41	Yes
CG 93	LS-7/R	Vacant	160.31	Yes
CG 94	LS-7/R	Residential	16.19	No
CG 95	LS-7/R	Residential	2.24	No
CG 96	LS-7/R	Residential	63.69	No
CG 97	LS-7/R	Vacant	64.75	No

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*[1] From British Columbia Assessment Authority (1981).

APPENDIX I

SOUTHERN ALTERNATIVES (km 70.0S to km 86.5)

APPENDIX I

SOUTHERN ALTERNATIVES (km 70.0S to km 86.5)

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APPENDIX I

SOUTHERN ALTERNATIVES (km 70.0S to km 86.5)

I.1 SURFICIAL GEOLOGY

The southern alternatives would traverse about 3.3 km of terrain that is moderately sensitive due to steep slopes and snow avalanches. Avalanche damage to towers would require maintenance at unpredictable times during the operation phase of the project. Impacts along this segment would be low to moderate but are of a different nature than those on the north side, where avalanching is not as prevalent. Based on the amount of sensitive terrain that would be traversed, the impacts of the Gitnadoix alternative would probably be at least as high as the Exchamsiks Ridge segments and higher than the Exchamsiks Crescent segment.

I.2 VEGETATION

The vegetation types are similar on each side of the Skeena River for this section of the study area, including successional, alluvial conifer, cottonwood, and coastal forests. Low impacts would result from either alternative. However, a southern route would be preferred for the following reasons:

1. less clearing would be required if the line was built parallel to the existing line,
2. the southern route avoids the bogs that are close to segment 0 between km 79 and km 82,
3. the southern route avoids removal of vegetative cover on the steep slopes of Exchamsiks Ridge if segment N were used.

I.3 WILDLIFE

There is a wetland complex just east of the existing line between km 69.5S and km 71S. Any new line here should be immediately adjacent to the existing line, to avoid crossing the wetlands unnecessarily.

Most of the vegetated islands between 70S and 86.5 are rated as moderately sensitive. They are all mild winter range for moose, and some of them probably have patches of good cover which should be avoided. They are also potential calving habitat for moose. If a route were selected which involved island-hopping in the main channel, constraints on timing of construction would be required.

The mouth of the Gitnadoix River, including the island on which IR76 is located, is rated high in sensitivity for two reasons. First, it is the edge of the Gitnadoix valley winter range, which is the most highly-rated wintering area for moose downstream of Terrace. However, the island on which the existing line is located appears to offer only moderately good cover, and a second line immediately adjacent to it would not have much additional impact.

Second, the mouth of the Gitnadoix is almost certainly on the flight path connecting the main Skeena valley with the very important waterfowl habitat in the Gitnadoix valley. This flight path is probably used frequently by many waterfowl. It is probably used for seasonal movements but not daily movements by swans, which utilize habitat upstream on the Gitnadoix River. Therefore, the collision hazard to swans here is probably lower than in some other areas. The least hazardous location for a new transmission line in this area would be immediately adjacent to the old one.

Available information indicates that the overall impact on wildlife would be low if a new line was located immediately adjacent to the old line. Timing constraints on construction would be required on the islands during the winter, but not during the calving period.

If the new line was located on the main channel islands opposite the mouth of the Gitnadoix River, the impact on wildlife would probably be moderate. Collision hazards would be more difficult to mitigate. Timing constraints would include the calving period as well as the winter.

This assessment could be changed by more site-specific information.

I.4 AQUATIC RESOURCES

These alternatives would make only one crossing of a Skeena mainstem channel in proximity (within 1 km) to a salmon spawning area. The potential impact of these routes on fishery resources is rated as low. These alternatives would be slightly preferable to a northern route using the Exchamsiks Crescent alternative, because no encroachment on the Skeena River would be required for transmission tower construction.

I.5 AGRICULTURE

Approximately two-thirds of these alternatives would traverse moderately sensitive class 3 agricultural lands. Much of this is wetland subject to flooding and has poor access. The overall impact for these alternatives would be low to moderate, significantly less than the proposed northern alternatives. Both of the northern routes traverse considerable land of high capability with good access and would have a relatively high impact.

I.6 FORESTRY

From a forestry resource perspective the southern alternatives may be slightly preferable to the northern options. Because southern routes would parallel the existing right-of-way, less new clearing would be required. In terms of loss of growing sites and total loss of standing timber volumes, the impacts of each alternative appear to be equivalent. In overall terms, impacts of either alternative would be moderate.

I.7 MINERAL RESOURCES

There are no mineral resource sites or claims on the south side of the Skeena River along these alternatives, therefore there is no sensitivity or impact. The mineral potential map shows no indication of mineral potential, suggesting that improved access would not likely provide beneficial impacts. There would be low impacts along the northern alternatives, therefore there is a slight preference for the southern alternatives in terms of mineral resources.

I.8 HERITAGE RESOURCES

These alternatives would be preferred to the northern routes from a heritage impact potential point of view, as most of the area which would be traversed is of low to medium potential for heritage resource presence. Areas of high potential would be in the vicinity of Gitandoiks Indian Reserves IRs 75 and 76, Dzagayap Indian Reserve IR 74 and the Skeena River shoreline opposite (south of) Ecological Reserve 63.

I.9 RECREATION AND CONSERVATION

The existing 287 kV route between km 70S to 86.5 crosses the mouth of the Gitnadoix River, a sensitive area for fishing, boating, and wildlife viewing. The areas which would be traversed by the southern route are less sensitive from a recreational point of view than the northern alternatives. Although the Gitnadoix River mouth is a sensitive area, actual impacts on recreational activities would be low because of the inaccessibility of the area and the presence of the existing line.

I.10 VISUAL RESOURCES

A route adjacent to the existing 287 kV route on the south side of the Skeena River could present an alternative to the high impacts on visual resources that would result from construction of the route on the northern shore. Several kilometres of the alternatives cross steep, forested, and therefore visually sensitive slopes. However, these sections pass low on the slope and are generally not visible from the north shore because of the natural screening provided by the forested islands in the Skeena River. The majority of these alternatives (10 km) would cross relatively insensitive terrain on valley bottoms, and would have low visual impacts. In contrast to the northern segments, these alternatives would have no areas of high visual impact because they avoid the Kasiks and Exchamsiks rivers and the Exchamsiks Ridge and Crescent segments.

I.11 LAND STATUS AND USE

The southern alternatives are near four Indian reserves (IRs 73, 74, 75 and 76) situated on the banks of the Skeena River. All are considered highly sensitive areas as well as possible constraints in routing a transmission line. The existing 287 kV transmission line cuts across Gitandoiks IR 75 and terrain constraints in that area may require transecting the same reserve with the 500 kV line. If avoiding land use conflicts is impossible, the impact of a route parallel to the existing line would be high. If the southern alternative were to avoid the reserve by being routed on the islands at the mouth of the Gitnadoix, there would be no impact on land status.

I.12 HUMAN ENVIRONMENT

The southern alternatives will be assessed from a socio-economic perspective during discussion with Indian bands in early 1983.

APPENDIX J

RESOURCE IMPACT RATINGS BY SEGMENT, IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

APPENDIX J

RESOURCE IMPACT RATINGS BY SEGMENT, IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

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TABLE J-1

SURFICIAL GEOLOGY IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings	Segment Length (km)	Length of Transmission Line (km) Causing Low or Moderate Impacts	
				Low	Moderate*1
A	Kloiya	nil	7.1	0	0
B	Rainbow	nil	13.1	0	0
C	Prudhomme	low	8.3	2.4	0
T	Channel	low	5.4	3.2	0
U	Minerva	nil	3.9	0	0
D	Tyee	nil	10.4	0	0
E	Lachmach	low	9.8	1.6	0
F	Khyex	nil	4.8	0	0
G	Ayton	nil	11.4	0	0
H	Telegraph	low	11.3	0.9	0
I	Khtada	low	18.2	4.0	0
J	Mt. Bucey	nil	6.8	0	0
K	Kasiks	nil	6.9	0	0
L	Salvus	nil	2.9	0	0
M	Exchamsiks Crescent	low	1.7	1.3	0
N	Exchamsiks Ridge	mod	1.4	0	1.4
O	Mt. Jackman	mod	15.8	0	9.0
P	Hudson	nil	7.8	0	0
Q	Exstew	nil	3.7	0	0
V	Exstew East	low	2.5	0.9	0
S	Crossing	nil	4.2	0	0
W	Dasque	low	12.4	1.0*2	0
X	Shames North	low	6.6	5.1	0
Y	Shames South	nil	5.6	0	0
Z	Klakelse Crossing	mod	6.6	0	1.3
R	Lakelse	mod	12.4	2.7	2.1

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*1 There are no high impacts.

*2 Uncertain due to incomplete mapping.

TABLE J-2

SURFICIAL GEOLOGY IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking	Length of Transmission Line (km) Causing Low or Moderate Impacts	
			Low	Moderate
1. Prudhomme(C)-Channel(T)-Lachmach(E)	low	3	7.2	0
Prudhomme(C)-Minerva(U)-Lachmach(E)	low	2	4.0	0
Rainbow(B)-Tyee(D)	nil	1	0	0
2. Ayton(G)	nil	1	0	0
Telegraph(H)	low	2	0.9	0
3. Mt. Bucey(J)	nil	1	0	0
Kasiks(K)	nil	1	0	0
4. Exchamsiks Crescent(M)	low	1	1.3	0
Exchamsiks Ridge(N)	mod	2	0	1.4
5. Hudson(P)-Dasque(W)	low	2	1*[1]	0
Exstew(Q)-Crossing(S)-Dasque(W)	low	1	*[1]	0
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	mod	3	0.9	1.3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	mod	4	6.0	1.3

---

*1 Uncertain due to incomplete mapping.

TABLE J-3

VEGETATION IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings	Additional Comments
A	Kloiya	high	muskeg-bogs, realign to avoid
B	Rainbow	low	aquatic, muskeg-bog alluvial forests
C	Prudhomme	high	muskeg-bog, new access required
T	Channel	low	
U	Minerva	high	aquatic, muskeg-bogs
D	Tyee	low	avoid small bog
E	Lachmach	low	avoid muskeg and alluvial types
F	Khyex	low	span tidal marsh and rare plants
G	Ayton	low	high on islands
H	Telegraph	low	preferred to Ayton Crossing
I	Khtada	low	span bog at km 52
J	Mt. Bucey	low	span bog at km 70S
K	Kasiks	low	
L	Salvus	low	
M	Exchamsiks Crescent	low	preferred to Ridge route
N	Exchamsiks Ridge	low	
O	Mt. Jackman	low	
P	Hudson	low	span bogs 98-99.2S
Q	Exstew	low	span bog at 96.7N
V	Exstew East	high	would be low if line were shifted north
S	Crossing	low	
W	Dasque	low	
X	Shames North	low	
Y	Shames South	low	
Z	Klakelse Crossing	low	
R	Lakelse	low	

TABLE J-4

VEGETATION IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	mod	2
Prudhomme(C)-Minerva(U)-Lachmach(E)	mod-high	3
Rainbow(B)-Tyee(D)	low	1
2. Ayton(G)	low	2
Telegraph(H)	low	1
3. Mt. Bucey(J)	low	2
Kasiks(K)	low	1
4. Exchamsiks Crescent(M)	low	1
Exchamsiks Ridge(N)	low	2
5. Hudson(P)-Dasque(W)	low	1
Exstew(Q)-Crossing(S)-Dasque(W)	low	2
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	low-high	3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	low-high	4

TABLE J-5

WILDLIFE IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings
A	Kloiya	nil
B	Rainbow	nil
C	Prudhomme	low
T	Channel	low
U	Minerva	low
D	Tyee	nil
E	Lachmach	low
F	Khyex	high
G	Ayton	mod
H	Telegraph	low
I	Khtada	low
J	Mt. Bucey	low
K	Kasiks	high
L	Salvus	low
M	Exchamsiks Crescent	nil
N	Exchamsiks Ridge	low
O	Mt. Jackman	low
P	Hudson	mod
Q	Exstew	high
V	Exstew East	mod
S	Crossing	mod
W	Dasque	nil-low
X	Shames North	mod-high
Y	Shames South	high
Z	Klakelse Crossing	nil
R	Lakelse	low

TABLE J-6

WILDLIFE IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	low	3
Prudhomme(C)-Minerva(U)-Lachmach(E)	low	2
Rainbow(B)-Tyee(D)	nil	1
2. Ayton(G)	mod	2
Telegraph(H)	low	1
3. Mt. Bucey(J)	low	1
Kasiks(K)	high	2
4. Exchamsiks Crescent(M)	nil	1
Exchamsiks Ridge(N)	low	2
5. Hudson(P)-Dasque(W)*[1]	mod	1
Exstew(Q)-Crossing(S)-Dasque(W)	mod	2
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	high	4
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	mod-high	3

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*[1] Alternatives P-W and Q-S-W are strongly preferred to either alternative involving the Shames flats.

TABLE J-7

AQUATIC RESOURCES IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings
A	Kloiya	low
B	Rainbow	low
C	Prudhomme	mod
T	Channel	mod
U	Minerva	nil
D	Tyee	low
E	Lachmach	mod
F	Khyex	nil
G	Ayton	nil
H	Telegraph	nil
I	Khtada	nil
J	Mt. Bucey	low
K	Kasiks	low
L	Salvus	nil
M	Exchamsiks Crescent	mod
N	Exchamsiks Ridge	nil
O	Mt. Jackman	low
P	Hudson	mod
Q	Exstew	low
V	Exstew East	nil
S	Crossing	low
W	Dasque	low
X	Shames North	nil
Y	Shames South	low
Z	Klakelse Crossing	low
R	Lakelse	low

TABLE J-8

AQUATIC RESOURCES IMPACT RATINGS, PREFERENCE RANKING AND SALMONID RESOURCE VALUES FOR ROUTE ALTERNATIVES

Route Alternatives	Route Segment(s)	Number of Salmonid Spawning or Rearing Areas in Proximity to Route	Route Closely Parallels Stream	Major New Road Access Required	Possible Tower Instability or Encroachment on Stream	Standard Const.	Helicopter Const.	Potential Impact Rating*1	Residual Impact Rating*1	Preference Ranking
Rainbow-Tyee vs Prudhomme-Lachmach routes	Rainbow and Tyee	4				x	x	1	(low)	1
	Prudhomme, Channel, and Lachmach	5	x	x		x		3	(mod)	3
	Prudhomme, Minerva and Lachmach	4	x	x		x		3	(mod)	2
Telegraph vs Ayton	Telegraph	0				x*2	x	0	(nil)	-
	Ayton	0						0	(nil)	-
Mt. Bucey vs Kasiks	Mt. Bucey	2				x		1	(low)	1
	Kasiks	3				x		1	(low)	2
Exchamsiks Crescent vs Exchamsiks Ridge	Crescent	1			x	x		2	(mod)	2
	Ridge	0					x	0	(nil)	1
Eastern Alternatives (km 92.9 to 113.6)	Hudson-Dasque	12		x(½)*3	x	x		2½	(mod)	4
	Exstew, Crossing and Dasque	8			x	x		2	(low)	3
	Exstew, Exstew East, Shames South, and Klakelse Crossing	5				x		1	(low)	2
	Exstew, Exstew East, Shames North, and Klakelse Crossing	4				x		1	(low)	1

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*1 The potential impact rating (range = 0 to 3) is equal to the number of listed construction conditions which will occur in each segment. Rating for helicopter construction is "0". The residual impact rating (range = nil to high) is the anticipated impact after mitigation.

*2 Impact Rating is "0" as no salmonid or other aquatic resource values are involved.

*3 New road access would be required for approximately half this segment.

TABLE J-9

AGRICULTURE IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings	Additional Comments
A	Kloiya	nil	
B	Rainbow	nil	
C	Prudhomme	nil	
T	Channel	nil	
U	Minerva	nil	
D	Tyee	nil	
E	Lachmach	nil	
F	Khyex	nil	
G	Ayton	low	poor access
H	Telegraph	nil	
I	Khtada	low	small isolated parcels
J	Mt. Bucey	mod	isolated wet lands
K	Kasiks	high	class 2, development expected
L	Salvus	high	class 2, development expected
M	Exchamsiks Crescent	nil	
N	Exchamsiks Ridge	low	small piece of class 2
O	Mt. Jackman	mod	class 2 and 3
P	Hudson	low	isolated class 3
Q	Exstew	mod	small piece class 2
V	Exstew East	low	class 5
S	Crossing	low	class 3 islands
W	Dasque	low	class 5
X	Shames North	nil	
Y	Shames South	high	some developed class 3
Z	Klakelse Crossing	low	small isolated parcels
R	Lakelse	low	class 5

TABLE J-10

AGRICULTURE IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	not applicable	
Prudhomme(C)-Minerva(U)-Lachmach(E)	not applicable	
Rainbow(B)-Tyee(D)	not applicable	
2. Ayton(G)	low	2
Telegraph(H)	nil	1
3. Mt. Bucey(J)	moderate	1
Kasiks(K)	high	2
4. Exchamsiks Crescent(M)	nil	1
Exchamsiks Ridge(N)	low	2
5. Hudson(P)-Dasque(W)	low	1
Exstew(Q)-Crossing(S)-Dasque(W)	low	1
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	high	3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	low	1

TABLE J-11

FORESTRY IMPACT RATINGS BY SEGMENT

Segment Name	Impact Ratings	Additional Comments
A Kloiya	low-mod	recreational reserve
B Rainbow	low-mod	TSHL A-01482, predominantly poor sites
C Prudhomme	high	helicopter logging
T Channel	high	helicopter logging, TSHL A-01482
U Minerva	high	TSHL A-01482
D Tyee	low-mod	TSHL A-01482, parallel to existing line
E Lachmach	high	helicopter logging, TSHL A-01482
F Khyex	low-mod	parallel to existing line
G Ayton	mod	TSHL A-03624, lower MAI than (H)
H Telegraph	mod	higher MAI than (G)
I Khtada	mod	parallel to existing line
J Mt. Bucey	mod	winter clearing of right-of-way may be necessary
K Kasiks	mod	good sites
L Salvus	mod	medium sites
M Exchamsiks Crescent	nil-low	
N Exchamsiks Ridge	low-mod	difficult access
O Mt. Jackman	mod	B.C. Timber licences
P Hudson	mod	good and medium sites
Q Exstew	low-mod	TSHL A-01452
V Exstew East	mod	good and medium sites
S Crossing	mod	cottonwood sites
W Dasque	mod	parallel to existing line
X Shames North	mod	
Y Shames South	mod	
Z Klakelse Crossing	mod	TSHL A-01452
R Lakelse	mod	TFL No. 1, B.C. Timber

TABLE J-12

FORESTRY IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	high	3
Prudhomme(C)-Minerva(U)-Lachmach(E)	high	2
Rainbow(B)-Tyee(D)	low-mod	1
2. Ayton(G)	mod	1
Telegraph(H)	mod	2
3. Mt. Bucey(J)	mod	1
Kasiks(K)	mod	2
4. Exchamsiks Crescent(M)	nil-low	1
Exchamsiks Ridge(N)	mod	2
5. Hudson(P)-Dasque(W)	mod	2
Exstew(Q)-Crossing(S)-Dasque(W)	low-mod	1
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	mod	3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	mod	4

TABLE J-13

MINING IMPACT RATINGS BY SEGMENT

Segment Name	Impact Ratings	Number of Impacted Sites Low	 Mod
A Kloiya	low	1	0
B Rainbow	low*[1]	3	0
C Prudhomme	slightly beneficial	0	0
T Channel	slightly beneficial	0	0
U Minerva	slightly beneficial	0	0
D Tyee	low	1	0
E Lachmach	nil	0	0
F Khyex	nil	0	0
G Ayton	nil	0	0
H Telegraph	low*1	4	0
I Khtada	nil	0	0
J Mt. Bucey	nil	0	0
K Kasiks	low	1	0
L Salvus	nil	0	0
M Exchamsiks Crescent	nil	0	0
N Exchamsiks Ridge	nil	0	0
O Mt. Jackman	low	2	0
P Hudson	nil	0	0
Q Exstew	low	1	0
V Exstew East	nil	0	0
S Crossing	low	1	0
W Dasque	nil	0	0
X Shames North	nil	0	0
Y Shames South	low	1	0
Z Klakelse Crossing	nil	0	0
R Lakelse	nil	0	0

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*1 Assuming careful co-ordination with the Ministry of Transportation and Highways.

TABLE J-14

MINING IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking	Number of Impacted Sites	
			Low	Moderate
1. Prudhomme(C)-Channel(T)-Lachmach(E)	slightly beneficial	1	0	0
Prudhomme(C)-Minerva(U)-Lachmach(E)	slightly beneficial	1	0	0
Rainbow(B)-Tyee(D)	low*[2]	3	2	1
2. Ayton(G)	nil	1	0	0
Telegraph(H)	low*[2]	2	4	0
3. Mt. Bucey(J)	nil	1	0	0
Kasiks(K)	low	2	1	0
4. Exchamsiks Crescent(M)	nil	1	0	0
Exchamsiks Ridge(N)	nil	1	0	0
5. Hudson(P)-Dasque(W)	nil	1	0	0
Exstew(Q)-Crossing(S)-Dasque(W)	low	3	2	0
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	low*[2]	4	2	0
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	low	2	1	0

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*[1] Slightly beneficial.

*[2] Assumes close co-ordination with Ministry of Transportation and Highways.

TABLE J-15

RECREATION AND CONSERVATION IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings
A	Kloiya	low
B	Rainbow	low
C	Prudhomme	moderately beneficial
T	Channel	nil
U	Minerva	low
D	Tyee	low
E	Lachmach	nil
F	Khyex	mod
G	Ayton	mod
H	Telegraph	nil
I	Khtada	mod
J	Mt. Bucey	low
K	Kasiks	mod
L	Salvus	low
M	Exchamsiks Crescent	mod
N	Exchamsiks Ridge	high
O	Mt. Jackman	mod
P	Hudson	low
Q	Exstew	mod
V	Exstew East	low
S	Crossing	nil
W	Dasque	low
X	Shames North	low
Y	Shames South	nil
Z	Klakelse Crossing	nil
R	Lakelse	low

TABLE J-16

RECREATION AND CONSERVATION IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	slightly beneficial	1
Prudhomme(C)-Minerva(U)-Lachmach(E)	slightly beneficial	2
Rainbow(B)-Tyee(D)	low	3
2. Ayton(G)	mod	2
Telegraph(H)	nil	1
3. Mt. Bucey(J)	low	1
Kasiks(K)	mod	2
4. Exchamsiks Crescent(M)	mod	1
Exchamsiks Ridge(N)	high	2
5. Hudson(P)-Dasque(W)	low	1
Exstew(Q)-Crossing(S)-Dasque(W)	mod	2
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	mod	3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	mod	3

TABLE J-1/

VISUAL RESOURCES IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings
A	Kloiya	mod
B	Rainbow	low-mod
C	Prudhomme	low
T	Channel	mod
U	Minerva	mod
D	Tyee	low
E	Lachmach	mod-low
F	Khyex	low
G	Ayton	high
H	Telegraph	low
I	Khtada	mod
J	Mt. Bucey	low
K	Kasiks	high
L	Salvus	low
M	Exchamsiks Crescent	high
N	Exchamsiks Ridge	high
O	Mt. Jackman	mod
P	Hudson	mod
Q	Exstew	high
V	Exstew East	mod
S	Crossing	high
W	Dasque	low
X	Shames North	mod
Y	Shames South	high
Z	Klakelse Crossing	moderate
R	Lakelse	low

TABLE J-18

VISUAL RESOURCES AND CONSERVATION IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	mod	3
Prudhomme(C)-Minerva(U)-Lachmach(E)	mod	2
Rainbow(B)-Tyee(D)	low-mod	1
2. Ayton(G)	high	2
Telegraph(H)	low	1
3. Mt. Bucey(J)	low	1
Kasiks(K)	high	2
4. Exchamsiks Crescent(M)	high	1
Exchamsiks Ridge(N)	high	1
5. Hudson(P)-Dasque(W)	low	1
Exstew(Q)-Crossing(S)-Dasque(W)	low	2
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	high	4
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	mod	3

TABLE J-19

LAND STATUS AND USE IMPACT RATINGS BY SEGMENT

Segment Name		Impact Ratings
A	Kloiya	low
B	Rainbow	high
C	Prudhomme	low
T	Channel	low
U	Minerva	nil
D	Tyee	low
E	Lachmach	low
F	Khyex	high
G	Ayton	low
H	Telegraph	low
I	Khtada	high
J	Mt. Bucey	nil
K	Kasiks	low
L	Salvus	low
M	Exchamsiks Crescent	nil
N	Exchamsiks Ridge	low
O	Mt. Jackman	low
P	Hudson	low
Q	Exstew	low
V	Exstew East	nil
S	Crossing	nil
W	Dasque	low
X	Shames North	low
Y	Shames South	mod
Z	Klakelse Crossing	low
R	Lakelse	low

TABLE J-20

LAND STATUS AND USE IMPACT RATINGS AND PREFERENCE RANKINGS FOR ROUTE ALTERNATIVES

Route Alternatives	Impact Ratings	Preference Ranking
1. Prudhomme(C)-Channel(T)-Lachmach(E)	low	2
Prudhomme(C)-Minerva(U)-Lachmach(E)	nil-low	1
Rainbow(B)-Tyee(D)	low-high	3
2. Ayton(G)	low	1
Telegraph(H)	low	1
3. Mt. Bucey(J)	nil	1
Kasiks(K)	low	2
4. Exchamsiks Crescent(M)	nil	1
Exchamsiks Ridge(N)	low	2
5. Hudson(P)-Dasque(W)	low	1
Exstew(Q)-Crossing(S)-Dasque(W)	low	2
Exstew(Q)-Exstew East(V)-Shames South(Y)-Klakelse Crossing(Z)	mod	3
Exstew(Q)-Exstew East(V)-Shames North(X)-Klakelse Crossing(Z)	low	2

TABLE J-21

HUMAN ENVIRONMENT SENSITIVITY RATINGS BY SEGMENT

Segment Name		Sensitivity Ratings*1	Additional Comments
A	Kloiya	low	Prince Rupert/Port Edward
B	Rainbow	low	potential settlement area - Port Edward
C	Prudhomme	nil	
T	Channel	high	adjacent to IRs 16 and 61
U	Minerva	high	near IRs 16 and 61
D	Tyee	low	potential settlement areas
E	Lachmach	nil	
F	Khyex	high	crosses Khyex IR 8
G	Ayton	high	near IR 65 and logging camp at Scotia, involves river crossing
H	Telegraph	high	involves river crossing
I	Khtada	high	crosses IR 10, near IRs 11, 11A, 70
J	Mt. Bucey	high	near IRs 26, 71, 72
K	Kasiks	high	near IRs 26, 71, 72
L	Salvus	low	Ministry of Transportation and Highways yard at Salvus
M	Exchamsiks Crescent	high	IR 73 is across river
N	Exchamsiks Ridge	high	IR 73 is across river
O	Mt. Jackman	high	IRs 73, 74, 75, 76 are across river
P	Hudson	high	involves river crossing
Q	Exstew	nil	
V	Exstew East	nil	
S	Crossing	high	involves river crossing
W	Dasque	high	adjacent to IR 85
X	Shames North	low	preferred by farmers to Y
Y	Shames South	mod	crosses farmer's property
Z	Klakelse Crossing	high	adjacent to IR 86
R	Lakelse	low	settlement in area

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*1 Preliminary sensitivity ratings have been provided (but no impact ratings or route preferences) pending the assessment of impacts on Indian resource and land use, and discussions with local residents. A high rating indicates potential disruption to Indian resource or land use.

APPENDIX K

PROJECT PERSONNEL

PROJECT PERSONNEL

The environmental study team for this project consisted of the following B.C. Hydro staff and consultants:

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